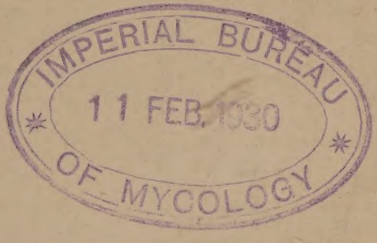
# EMPIRE COTTON GROWING CORPORATION

## REPORTS RECEIVED FROM EXPERIMENT STATIONS

1928-1929

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# CONTENTS

# PREFACE

By J. C. WILLIS, M.A., Sc.D., F.R.S.

This preface, for convenience sake, is made to follow the lines of that of the previous year, which may with advantage be consulted. Its perusal should also be amplified by reading the informative summaries provided by the authors of the various reports.

The feature of the year in regard to breeding work is the success which has attended the growth of the variety known as U.4, which was first selected by Mr. Parnell, the Corporation's plant breeder in South Africa, from a variety that is believed to have come originally from Uganda. This strain is now itself already in process of improvement by further breeding and selection in several places.

It was explained in last year's preface how the first survey of conditions in South Africa indicated that breeding against jassid was the work most urgently required. As is more fully described by Mr. Milligan in his introductory remarks (South Africa), this work was at once put in hand, and with great success, U.4 and other jassid-resistant varieties being produced by a piece of selection work of the highest class. The present reports, both for South Africa and for many of the dependencies to the northward of it, deal very largely with the extension of work with U.4, which has proved to be the best of the jassid-resistant varieties. It is described by Mr. Milligan (p. 29) as "a remarkable strain, possessing, in addition to jassid-resisting qualities, drought resistance, prolific flowering capacity, quickness in forming buds and setting fruit, freedom from shedding, and in the bulk, which is far from being uniform, a large number of individuals with excellent lint characters and high ginning percentage."

Not only has it done well in the Union of South Africa, but also in Rhodesia, where it seems likely to form the parent variety for selection. In addition to being resistant to jassid, it has proved a first-rate cropper, giving yields up to and exceeding 1,500 lbs. per acre of seed cotton. In Swaziland it has been so successful that it is expected that no other strain will be planted in the coming season. In Southern Rhodesia an unfavourable season subjected it to a severe test, and Mr. Cameron states that "in a really favourable season we should be justified in expecting returns from U.4 cotton far in advance of anything which previous experience of other cottons in Southern

Rhodesia has warranted in the past." In Northern Rhodesia U.4 gives promise of being able to withstand local conditions, and it is now being multiplied up for distribution. In Nyasaland also the strain seems successful and, as Mr. Ducker writes "it seems probable that Nyasaland will have as much reason to be grateful to Mr. Parnell as has Southern Rhodesia, since this strain has in the past season shown itself as suitable for Port Herald as for Makwapala."

This is really a wonderful record for a new plant variety, and the Corporation, and all concerned, may be warmly congratulated upon the success attained, a success which bids fair to bring South Africa and Southern Rhodesia into the list of important producers of cotton in the Empire.

In Nyasaland, in addition to U.4, Over-the-Top is still under trial. Although Mr. Ducker reports that it is showing "increasing difficulty in coping with conditions" at Makwapala Station itself, this variety has done well in neighbouring districts.

Going further North, in Uganda progress is being made with re-selections from existing strains, that known as S.G.27 being the most promising, while S.G.29 gave good results in several places. Of the newly imported varieties, Acala seemed promising, and one plant was selected for the progeny rows.

In the Sudan, the disease known as leaf-curl became formidable last season in some parts, and breeding against it may have to be carried out. Some indication has been obtained of a connection between jassid resistance and leaf-curl immunity, and if this proves well founded, U.4 may afford a good basis for further work : experiments with it have already shown that it retains its quality of jassid resistance.

It is unfortunate that hybrids of Sakel × Sea Island, which were providing some especially promising material for future propagation, appeared to be very susceptible to leaf-curl and had to be scrapped. Resistance to this disease seems commoner in cottons of American type and in native Sudan cottons. These are accordingly being used in hybridisation work.

Among American cottons that may be useful for those parts of the Sudan where cotton is grown under rainfall, a strain of Delta Webber, with more upright habit of growth, has given satisfactory results in experiments, and over 40 acres of it are being grown this season, under the name of Delrect, as the first stage in bulk propagation.

In Fiji the breeding work is concerned with both Sea Island and the Kidney variety brought from New Guinea. The former variety suffered this year from the effects of a wet season. Owing to the small market that exists for this type a few selected strains only are being

grown, and the work of the Station was directed chiefly to the work on Kidney cottons. The beginning of this work was described in last year's Report. These trials have been continued, and in the past year the plants stood up well to the unusually wet season. The whole Sigatoka Valley area was planted with four of these varieties, and after a severe attack of jassid had fortunately been overcome by the onset of finer weather, the plants put on a completely new growth ; excellent results were obtained, as great a yield as 2,000 lbs. an acre (seed cotton) being recorded in some instances. The variety K3-2 seems on the whole the most promising, and it is being improved and multiplied up as rapidly as possible. It will be noticed (page 262) that this promises to be a very good cotton, with a staple of about 34 mms. (1·36″).

Incidentally it would appear that selection work for jassid resistance may prove to be as well worth while in Fiji as it has been in other countries.

In Queensland the exceptionally unfavourable season almost completely spoiled the breeding work last year, but some valuable information was obtained on such factors as plant growth and flower counts.

But, as stated last year, to breed improved cottons that shall be adapted to their several environments, though on the whole the most important thing, perhaps, is not the only line of attack upon the general cotton problem. In South Africa the industry might probably have died out had not a jassid-resistant strain been discovered and developed, but in Queensland, for example, bearing in mind the high labour costs, to reduce the general cost of working and if possible also to increase the efficiency of the several farming operations is perhaps the most desirable thing. Consequently, in the report from that country we find much space devoted to cultural experiments having this object. The results of these experiments, so far as they have yet gone, are summarised in Mr. Wells' report (page 1).

Much similar work is recorded in many of the other reports. For instance, under South Africa it is noted (page 34) that fallowing depresses the early growth of the cotton.

In a great number of stations trials were made to find the best distance for spacing the plants in the rows, spacings of 6–12–18–24 inches being tried. In some places there was found to be no very great difference, though in Swaziland and in Queensland it was thought that the closer spacing was rather the better, as indeed is normally the case in the United States of America, where, however, the boll weevil is a determining factor, that does not occur in the Empire fields, in necessitating early maturation.

Other important experiments deal with the best time for planting, and in general it was found that earlier (but not too early) planting gave better yields.

A number of other experiments of this kind are to be found described in various parts of the reports. For instance, in Queensland planting in hills 3 ft. 6 ins. apart was found to be undesirable as compared with planting in drills and thinning to 2 ft. apart, while thinning was found more advantageous while the plants were still comparatively small. Experiments were also conducted at several stations on the results of manuring and of green manuring.

In Fiji and at Candover (Natal) ratooning was tried; the results were unsatisfactory as regards quality and quantity of lint, though there is, of course, a saving on labour.

In Nigeria experiments are described on cultivation by means of cattle which have not been widely used for this purpose there as yet.

The experiment in co-operative farming which is being carried out in that country in connection with the Corporation's seed farm is also of considerable interest.

Under South Africa, Sudan, etc., will be found a number of notes upon more general physiology. It was observed that with later planting, though the growth might ultimately be much the same, the number of flowers was markedly less. A high degree of correlation was found between temperature and growth-rate and flowering. In the Sudan it was found that a low ginning outturn appears to be associated with deficient soil moisture, and that suppression of fruiting branches under conditions of excessively high temperature is due to their actual conversion into vegetative branches which usually remain in a partly developed condition, described as "monopodial tufts." Work is also being done in the Sudan upon the comparative fertility of the different layers of the soil, upon bud shedding, and upon "blind seeds," which appear to be due to lack of water.

The most important general question that comes under this heading and is perhaps best dealt with here is that of the rotation of crops—for, to make a permanent success of cotton (in the same sense as, for example, the "root" crops of turnips, potatoes, and the like, are a permanent success in Great Britain), it must be made to form one member in a rotation of crops, and not the sole crop that is taken off the same ground year after year. The standard old English four-course rotation is wheat—roots—barley—clover—and some similar regular rotation is wanted for cotton. One difficulty which confronts those engaged in this work is that in the various

countries in which cotton is now established in the British Empire conditions differ very much, and a rotation that may suit one may be quite unsuitable to another. A special obstacle in some of these countries is that with the hand-to-mouth life of most of the indigenous population, each crop in the rotation must itself be one that will commend itself to the native as being worth while to grow, either as food or as a money crop.

A great many experiments with rotations are described in this volume, and we may briefly call attention to some of the more important facts that have been discovered. In South Africa, for example, three promising crops have been found—tepary beans, soy beans, and sunflower—for all of which, but especially for the second, there is a good market. It remains to determine the best spacing, time of planting, and so on, and the best method of incorporating these crops into a series that will form a really good rotation (like the English four-crop course), keeping the soil in good condition and draining food from it at a fairly evenly balanced rate, having regard to its actual constitution. There is evidently still a great deal to be done, and it is not yet even certain that these crops are sufficiently distinct in their requirements, but a good start has been made.

At Ingwavuma (Swaziland) groundnuts, which may almost be regarded as "roots," seem to be doing well, also sorghums, which might correspond to wheat or barley in the English rotation. Sunflower, groundnuts and two kinds of beans have done well in other parts of Swaziland also. At Candover (Natal) buckwheat—another crop with a good market—was found to do well in addition to those already named.

In Southern Rhodesia and elsewhere, maize—a crop with an unlimited market—has already been found to form a very good rotation with cotton, though probably a third and even a fourth member might with advantage be included. Pigeon-peas, tobacco, and maize are on trial in Nyasaland; beans and millet have been found useful in Nigeria, and so on.

Thus the outlook for the discovery of satisafctory rotations that include cotton may be described as distinctly promising, and the next problem may be to persuade the growers to make use of the results obtained. This question of how the results of the experiment stations can best and most expeditiously find their way into general agricultural practice is well known in this country, and is indeed doubtless nearly universal: it can only be said that each Station is probably best able to devise for itself the means best adapted to the cultivators in its district.

Turning finally to the matter of pests and diseases to which, as explained on page xi. last year, the cotton plant is so particularly subject, there is a good deal of matter in these reports that is of considerable interest. The good results of special breeding for jassid resistance have already been described.

The most widespread and damaging pests are the bollworms, which were also discussed in last year's preface, and which are dealt with in most of this year's reports. In general, it may be said that the bollworm attacks last season were light, but there were bad ones in Nigeria, Southern Rhodesia and Candover (Natal). In Southern Rhodesia the attack of American bollworm drew special attention to this pest, and it is considered likely that it may be countered by selection of prolific and early-maturing strains (page 107). Light trapping was tried on the large scale upon the Estates of the Premier Cotton Company of South Africa, and details are given (page 85) of the work carried out. A considerable capture was made of the moths of the Sudan bollworm, especially when the acetylene light was exchanged for electric, but the American bollworm was less affected.

The next most important pest is perhaps the stainer—and the attacks of this also have been light last season, except in Northern Rhodesia, where trapping was tried with some success, and at Candover (Natal), where it was found that the early-planted cotton suffered least.

Other pests that deserve special mention are the corn-ear worm, which is very serious in Queensland when the cotton is planted late (page 22), and aphis in Nyasaland (page 244), Southern Rhodesia (page 119), and Northern Rhodesia.

Among diseases may be mentioned the leaf-curl, which has proved serious in the Sudan (page 152). The experiments in breeding resistant varieties have already been touched upon above. Blackarm was widespread and severe in parts of Uganda (page 198).

Studies upon bud shedding are being made in the Sudan (page 193), where it has been found that it was "the major factor in determining the low yields at Shambat . . . Most of the bud shedding takes place at a relatively early stage (bracteoles 0·8 mm. in diameter), and its effects are visible in diminished flowering about two weeks later. Excessively low humidities were probably largely accountable for the high rate of bud shedding."

In conclusion, attention may be drawn to the growth of the work at the Corporation's seed farm at Daudawa (Northern Nigeria), where about 36,000 lbs. of seed was secured and handed over to the Agricultural Department for distribution (page 246). Mention

must also be made of the special difficulties with soil that are being experienced at Makwapala in Nyasaland ; of the results of spinning tests and the brokers' reports carried out for Uganda and the Sudan and other countries ; and the many other interesting features in which the reports abound.

Abstracts will be found at the commencement of each report. Special attention may be drawn to Mr. Milligan's note on the work in South Africa, and to the appreciation of the work in Southern Rhodesia by the Minister of Agriculture and Lands. All these introductory remarks may be read with advantage in connection with this preface.

# QUEENSLAND

## REPORT ON THE WORK OF THE CALLIDE COTTON RESEARCH STATION, BILOELA, FOR THE YEAR ENDING JUNE 30, 1929.

BY

W. G. WELLS.

SUMMARY.

The climatic conditions existing during the past season at the Research Station have been very unfavourable for growing profitable crops of cotton. The results obtained, therefore, have been very much below the average yields of previous crops. This is really the first crop failure in the six seasons that the Station has been established, and as the yields in the previous years were of a high order, the results obtained this season cannot be taken too seriously.

The explanation of such a complete failure as was experienced in many of the plots lies in the fact that the planting rains did not occur until late in the sowing season. The results obtained in the Time of Planting Experiments of previous seasons have always indicated that late planting is liable to severe losses from insect attack and excessive vegetative growth. The yields in most of the plots of this season have thoroughly demonstrated the validity of the conclusions drawn from the previous experiments as to the dangers of late planting.

Most of the experiments have been robbed of the greater part of their interest, therefore, through the loss of their yields. Wherever it has been possible, however, information appearing to be of sound value has been obtained on such factors as plant growth, flower counts, and in some few cases, boll production.

The results of the operations of this season may be briefly summarized as follows :—

1. Early planting undoubtedly increases the possibilities of obtaining good yields on the average of the soils of the Research Station.
2. The results obtained by a majority of the growers in the surrounding district are in keeping with this conclusion.
3. Planting soaked seed may be of advantage under conditions of light planting rains.

4. Planting late-sown cotton in pairs of rows, 6 feet between the pairs and 4½ feet between the rows of each pair does not appear to be of advantage on the Station soils. Plant growth indicated, however, that on soils where very rank growth may be produced, this system should be investigated.
5. Planting cotton in widely spaced hills (3½ ft. apart) as compared with planting in drills and then thinning to 2 feet apart, does not appear to be desirable from the standpoint of either yield or efficiency of cultivation.
6. Thinning late-sown plants when they are 6–8 inches high appears to be more advantageous than when they are either 10–12 or 14–16 inches high.
7. One-foot spacing of late-sown plants in rows of 4 feet apart appears to produce a greater number of flowers per acre than either 2-or 3-foot plant spacing, as is also the case where the rows are 4½ and 5 feet apart. Such a spacing is more susceptible to climatic variations, however, so the greater flower production may not result in a greater yield. Plant growth indicated that possibly under less adverse seasonal conditions, wider spacing of late-sown plants may be more beneficial.
8. Applying fertilizers as top dressing when the plants are well established and the early summer rains have started may be of more advantage than putting the fertilizers into the drills before or at planting time.
9. The Corn-ear worm is undoubtedly one of the most serious problems that the Queensland farmer has to solve, when cotton is planted late and its growth is rank. Early planted cotton, however, is comparatively free from severe attacks of this pest.

The Report deals with the experiments of this season, from which sufficient evidence has been obtained to allow of the above conclusions being made. A description of the seasonal conditions is also given, with graphs showing the rainfall and the temperature records for this past season, together with a graph showing the variation in monthly rainfall for the past five years (pp. 24—27). Likewise, the breeding operations are described and the incidence of insect pests reported.

### Seasonal Conditions.

The seasonal conditions under review have undoubtedly been the most unfavourable for cotton-growing of any that have been experienced since the Station has been established. Following a total of 2·57 inches of rainfall in June, well prepared seed beds were obtained in all of the plots. Unfortunately only three light showers yielding a total

of 0·43 inches occurred during July and no rain fell at all in August. Such conditions dried out the upper surface of the seed beds to such an extent that good rains were necessary to enable a satisfactory strike to be obtained. It was impossible, therefore, to plant on the showers in September and October, although in areas within a few miles of the Station where the precipitations were of a heavier nature, good strikes were obtained on sandy loamy soils. Sufficient rain to enable a strike to be obtained did not occur until the 5th November, when 0·90 of an inch fell. Unfortunately, no further rain fell until the 19th, so that any irregularities in the depth of planting badly affected the rate of germination, as such a light precipitation evaporated very quickly under the conditions of high maximum temperatures which existed during that period. Good rainfall was experienced early in December which enabled excellent strikes to be obtained. Showery conditions prevailed from then on to the 25th of the month, after which a dry period accompanied by very high maximum temperatures existed until the 12th January. Scattered light showers occurred from this date until the 7th February, but high temperatures were maintained throughout most of the period. A spell of continuous showery conditions was then experienced until the 23rd of the month, when a long period of hot dry weather again set in, which was unbroken, with the exception of a storm of 0·91 of an inch on the 18th., until the 28th of the month. A good fall occurred then, followed by further rains during the first four days of April. This wet spell terminated the unusually long period of abnormally high maximum temperatures which persisted with only slight interruptions from the first of January. With the cooler weather excellent dry harvesting conditions were experienced until the middle of June, when a few light showers occurred. Killing frosts occurred on the 28th, 29th, and 30th April which destroyed all top growth. Rather low temperatures were then experienced until the 24th May, when a period of four nights of severe frosts was experienced which completely froze all unopened bolls of a size less than half developed.

### Cotton.

The yields, as a whole, have been the lowest that have been obtained on the Station. In many of the plots where very heavy yields have always been obtained, no picking was made this season. The explanation lies in the late planting, followed by an unusually wet February and a series of very severe corn-ear worm attacks.

The rain of the 5th November was just sufficient to obtain a strike under conditions of absolute proper depth of planting and covering of the seed. As some time elapsed before further rain fell, a very irregular

rate of germination occurred in most plots and under the existing high temperatures many of the seedlings that appeared late died off. This feature was reported generally by the farmers throughout the district who planted on the same rain. Following on the rains of the 4th and 5th December the ungerminated seed in the November planting sprouted. This resulted in a very uneven growth of plant being obtained ; many of the plots by the end of January had plants 3 ft. high in the same row as later germinated plants which were only 12 to 18 inches high. This may explain the low yields and rather high degree of corn-ear worm attack which was experienced in the November plantings on the Research Station. In plantings on farms in those portions of the district where a heavier fall of rain occurred on the 5th November, much better yields were obtained and decidedly lighter corn-ear worm attacks were experienced. Likewise, in previous seasons, early November plantings on the Station have given good yields.

The plants made fairly satisfactory growth up to the end of January over the whole of the Station, the early December plantings looking particularly promising. However, under the influence of the two long pronounced wet periods which occurred in February, nearly all plantings showed a decided tendency to produce an excessive vegetative growth. The situation was further complicated by the high temperatures and dry period which existed during the first half of March. The succulent vegetative growth reacted to such severe conditions and considerable square shedding occurred. The plants toughened up nicely, however, and might have eventually developed a good crop but for the wet period which occurred from the 27th March to the 4th April, during which about six inches fell. This caused a general " bolting " of the plant growth with the result that much of the Station's crop averaged 5 to 6 feet in height. Corn-ear worm attacks during the latter part of March and early in April further aggravated the tendency to excessive growth. The result of such a combination of adverse conditions, together with early killing frosts, was that the crop over the whole of the Station was picked by the 8th June, fully a month earlier than usual.

An interesting example of the effect that the condition of the soil may have on the cotton plant was noticed on several low lying portions of the Station where the heavy rains caused an accumulation of water for periods of a day or two at a time. In such locations the plants were of a light yellowish green, as compared to the dark rich green of the plants over the rest of the Station. They were also shorter and bore very good to even heavy crops of cotton of good quality.

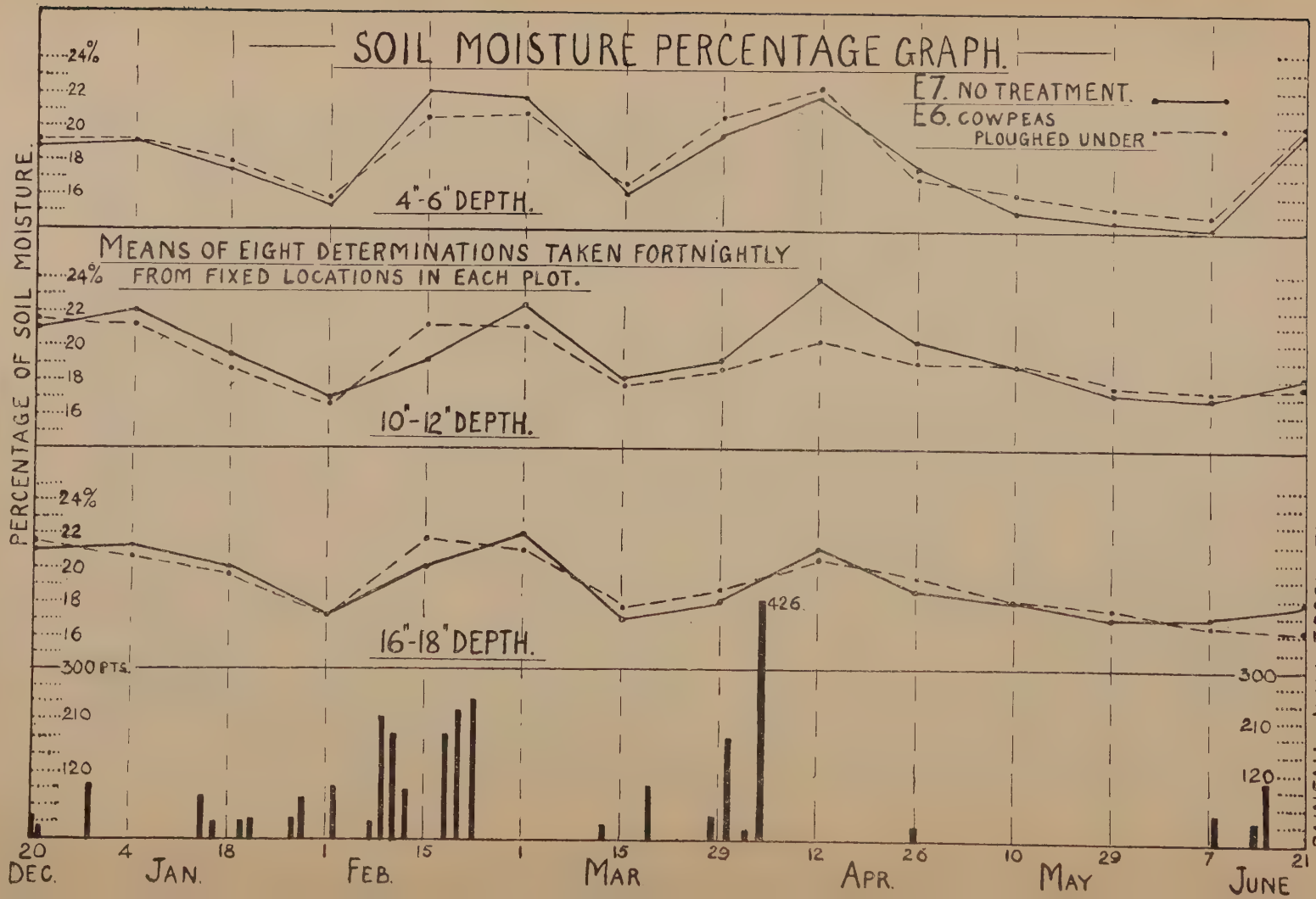
This checking of the growth of late planted cotton by partial water-logging of the soils has been noticed before on the heavier clay soils both in this Valley and in the Wowan and Dululu districts. A sort of physiological drought effect on the plant is produced which controls the growth to a marked extent and thus allows profitable crops to be produced when the contrary would be expected. Similar results were also obtained this season on the irrigation project at Theodore. There, where the late November crops on clay soils received a heavy soaking irrigation in mid-January, the plant growth was of only moderate development and much heavier crops were produced than on crops of similar date of planting in the Callide Valley. This was particularly so if the cultivation following the irrigation was unduly delayed. The same result was not obtained, however, on the rich alluvial loamy soils at Theodore. One late-planted crop on such soil was inspected which had only a few scattered diseased lower bolls. A very rank succulent growth had developed there under the wet February conditions and an attack by the corn-ear worm had practically destroyed the squares formed over the rest of the season.

### Cotton Experiments.

The majority of the experiments of this season have been badly affected through irregular time of germination, terminal loss, hail damage and, in many cases, corn-ear worm attack. The yields in many have therefore been of little value and have not been considered. In some of such experiments, however, the plants of the first germinations developed fairly normally and it appeared possible to obtain some information on such characters as average boll weight, number of 4- and 5-locked bolls per plant, etc. This was deemed desirable in order to add to the data that are being collected in the different experiments, many of which are being conducted over a series of years. These have been fully described in previous Annual Reports of the Station, so only the data obtained this season will be discussed in the account of any experiment.

The method used this season to obtain material for examination was to select a number of plants in comparable positions in each border. These locations were spaced at regular staggered intervals in the three inner rows of each plot of each treatment. The only selection exercised was when the plant at the selected position number had lost its terminal or was adjacent to a blank space, in which case the nearest suitable plant with a terminal was taken.

*Green Manuring.*—The experiments for testing the value of green manuring crops were such complete failures this season that no data


SOIL MOISTURE PERCENTAGE GRAPH.
E7. NO TREATMENT.
E6. COWPEAS PLOUGHED UNDER
4"-6" DEPTH.
MEANS OF EIGHT DETERMINATIONS TAKEN FORTNIGHTLY FROM FIXED LOCATIONS IN EACH PLOT.
10"-12" DEPTH.
16"-18" DEPTH.
PERCENTAGE OF SOIL MOISTURE.
24%
22
20
18
16
300 PTS.
210
120
426.
RAINFALL = INCH = 300 POINTS.
DEC. JAN. FEB. MAR APR. MAY JUNE
20 4 18 1 15 1 15 29 12 26 10 29 7 21

could be collected. A series of soil moisture determinations was carried out through the growing season, however, in an endeavour to ascertain if there was any effect on the moisture-retaining capacity of the soils in the second season after a cowpea crop had been turned under. The soil moisture percentage graph (p. 6) shows the data obtained for the two plots.

The graphs would appear to indicate that during dry periods the soil at the 4 to 6 inch level in the green manurial plot tended towards a slightly higher percentage of moisture than did the soil at the same level in the untreated plot. During a prolonged wet period in February, however, the latter soil had a higher capacity of from 1 to 1·5%. The untreated soils at the 10-to-12-inch levels showed a general tendency to a slightly higher percentage of moisture during dry periods. In contrast to the upper soils, the treated soils at the 10–12 inch level showed a tendency to a higher moisture percentage during the first part of the wet season, but when heavy storms occurred the *un*treated portions had a higher percentage. The results in the soils at the 16–18 inch level were somewhat similar.

It is not clear as to what is the explanation of these results. It is suggested, however, that possibly the cowpea crop had a sort of leavening effect on the soils. This would allow of quicker and therefore deeper penetration by light rains. The untreated soils, being of rather a clayey type of rich alluvial loam, might retard the penetration of light rainfall. Heavy rains would thus be required before the moisture would penetrate to the 10–12 inch level. The portions of the graphs covering the prolonged wet period in February appear to bear out this suggestion, as here the lower treated soils show a decidedly quicker response to the rains than do the untreated ones ; but a fortnight later, during which the heaviest storm of the period occurred, the untreated soils had a higher percentage of moisture.

A new series of moisture determinations has been started for the coming season in order to obtain further evidence on this subject. The same untreated plot of this series will be compared with an adjacent plot on which a cowpea crop of an estimated tonnage of 14 tons of greenweight was grown and turned under during the 1928/29 season. It is proposed to carry out the moisture determinations and the testing of the power of nitrification factor over several seasons until no difference in the results is obtained, in order to ascertain how long a green manure crop may affect a cotton crop.

*Fallowing Experiment.*—The yields from this experiment were so low as to be of little value. Very rank growth was produced both in the plot following a fallow after Giant Panicum from the 19th March,

1928, and in the plot following a cotton crop with only a fallow from the 23rd July. The yields obtained were 73·25 lbs. per acre for the crop following the long fallow and 107 lbs. for the crop following the short fallow. The yields cannot be taken as indicative of the merits of the two methods, as throughout this series the plot with the most irregular spacing yielded the heaviest. This was because with the widely spaced plants, more sunlight and air were able to reach the lower bolls, thus reducing boll rot losses and insect attack.

*Time-of-Planting Experiment.*—The adverse climatic conditions prevented the regular programme of monthly plantings, starting in September, from being carried out in the first two months. Accordingly the experiment was re-designed so as to compare early and late November plantings with early and late December ones. Only one November planting was obtained, however, that being made on the 8th of the month. One planting was obtained on the 11th December and another on the 19th of that month. Unfortunately a delayed complete germination was obtained in the November planting so the yields are not really true indicators of the possibilities of an early November-planted crop on the Station soils.

The early December rains allowed of a good strike being obtained for that month's plantings of the experiment. Rapid growth was made in the two earlier plantings during December, but under the prolonged period of high temperatures during early January the plants toughened up and gave excellent promise of producing profitable crops. The plants of the 11th December sowing were of an especially fine type and by the end of January were easily the most promising ever produced in the December plantings on the Station.

The November planting flowered considerably earlier than did the later ones, flowering being fairly regular by the 6th February in the former, whereas it was not until the 18th of the month that flowers in any quantity could be seen in the later sowings. The flower counts for February indicate that the early December planting produced only 25 per cent. as many flowers as did the November planting, and the late December planting produced only 8 per cent. During March the figures improved, but even then the early December planting produced only 51 per cent. as many flowers as did the November one, while the late December sowing produced only 38 per cent. of the production from the earliest planting.

Generally speaking, by the 20th of February the November plants were carrying a nice crop of bolls and squares. Following the rainy season, however, excessive vegetative growth developed which in conjunction with the severe corn-ear worm attack caused nearly a

complete loss of squares and even the destruction of most of the lower bolls. Bolls started opening by the beginning of March, but it was not until the 21st of the month that opening was general. The plot was not picked until the 18th May in order to obtain all of the crop in the one picking. The yield was at the rate of 167 lbs. per acre.

The 11th December planting entered February in excellent condition and had only moderate rainfall been experienced in that month, it is possible that this planting would have yielded heavily. The excessive rainfall of February, however, forced a very luxuriant growth in this planting, with the result that square shedding was severe. A very heavy corn-ear worm attack was also experienced during February, March and April so that practically no bolls set over the upper portions of the plants. The crop of bolls developed was so light that no picking was made until the 7th June, when a yield at the rate of 81 lbs. per acre was obtained.

The late December planting was practically an entire failure with only a few scattered open bolls which were not harvested.

The results are in keeping with those obtained in the Time-of-Planting Experiment of previous seasons. While the November planting was made early enough to have given much heavier yields ; the delayed germination really produced plant growth more similar to late November plantings of previous seasons. Comparable returns were also obtained by farmers on similar soils adjacent to the Station. In contrast to these, however, excellent yields were obtained within a few miles of the Station. These sections received storms during the latter half of October which allowed planting to be accomplished and the early November rains thoroughly established the seedlings. The results over a series of seasons indicate that September and October plantings offer the best chances of obtaining profitable yields in the Callide Valley. The growers should therefore make every effort to establish early well prepared seed beds in order to be able to obtain a strike on the first planting rains of the season. The figure in this Report illustrating the monthly rainfall at the Research Station for the last five seasons, clearly indicates that sufficient rain occurs in June to enable a seed bed to be prepared during that month. It is believed, therefore, if the growers plan their operations so as to enable ploughing to be done in June and early July, much of the difficulty of obtaining early strikes will be overcome. Certainly seasons will occur, such as this past one, where even well prepared seed beds will not enable a strike to be obtained owing to scanty rainfall. It is pointed out, however, that this is the first season in the six that the Research Station has been established, in

which it has not been able to obtain a strike in late September or early October on early well prepared seed beds. An examination of the rainfall figure will show that the precipitations have been very light in September, so it is believed that early planting can usually be accomplished if the proper methods are used. As early planting seems to be correlated with heavy yields and escape from corn-ear worm attacks; it is believed that this is the key to successful cotton growing in the Callide Valley.

*Wet versus Dry Seed Planting Experiment.*—A modification was made in this experiment for this season in that the whole of it was planted in drills instead of as in the past when the two treatments were planted in both furrows and drills. Unfortunately, the surface soils dried out too much before the programme of planting operations allowed of this experiment being sown following the November rain. It is to be regretted that this was not accomplished as the conditions would have given the best possible test of the benefit to be obtained from sowing soaked seed.

The planting was made on the 12th December and the observations taken on the rate of germination indicated that even under the almost perfect planting conditions the germination of the soaked seed was fully 24 hours ahead of the dry seed. A count of the percentage of stand existing, based on 2 ft. perfect spacing, made 5 days after planting, showed the wet seed to have 60 per cent. stand as compared with 40 per cent. for the dry. Three days later another count showed 85 per cent. stand for the wet seed and 80 for the dry.

No appreciable difference could be noticed in the rate of growth of the two treatments at the time of thinning on the 5th of January when the plants were approximately 6 inches high. During the early period of square formation the soaked seed treatment appeared to produce at a slightly heavier rate, although no counts were made to ascertain the percentage difference. Both treatments suffered alike from the excessive wet season, with the result that rank vegetative growth was produced over most of the plots.

The yields under the conditions have no significance as they were obtained from portions of the plots where flood water checked the growth of the plants. In the plots harvested the yields were at the rate of 213 lbs. per acre for the soaked seed treatment and 218 lbs. for the dry seed.

*Paired Row Experiment.*—The plan of this experiment was changed this season from that of previous ones in that only regular spacing of rows $4\frac{1}{2}$ ft. apart was compared with pairs of rows—the pairs being 6 ft. apart and the two rows of each pair $4\frac{1}{2}$ ft. apart.

This allowed of a greater number of comparisons between the two treatments, and it is believed gave more reliable results for the experiment.

A statistical treatment of the results by the "Student" method failed to show any significant difference between the plot yields of 12 comparisons—the odds being only 2·84 to 1. As there was practically no difference in the average number of plants per plot, it is believed that the yields are a true indication of the merits of the two treatments under the conditions under which they were conducted.

The results of this experiment in previous seasons have been somewhat similar. It would appear, therefore, that over a series of years on the soils of the Research Station there is little advantage to be gained by spacing the rows into pairs in such a manner as to allow more light and air to penetrate to the lower portions of the plants. The explanation may lie in the fact that most of the soils on the Station contain a fairly high percentage of clay. During each season in which the experiment has been conducted a period of high temperatures and dry weather has been experienced. It is probable, therefore, that when such periods occur enough drying out of the clay soils takes place to check the development of the plants sufficiently to destroy the value of the pairing of the rows. During this past season such conditions existed during the latter half of January and again in March, following the wettest February in the history of the Station. Flower counts, from the 26th February until the 30th March, made in twenty 100 feet sections of rows in each treatment, showed that the plants in the regularly spaced rows produced only 87·8% as many flowers as did those in the paired rows. When the data were corrected, however, to represent counts from equal areas, there was no difference on an acre basis. This would indicate that some advantage was gained by wider spacing of the rows as regards the development of the plants, but the loss in row space per acre counter-balanced any such benefit.

Such conclusions appear to be borne out by the growth of the plants in most of the plots on the Station. It is seldom that excessively rank development of plants occurs unless either some peculiar soil condition exists, or an insect attack occurs. Under either of these conditions rank vegetative growth may develop if a very wet period is experienced. It is questionable if a pairing of the rows could be expected to be of assistance then because the controlling factor is the crop of bolls and squares, and the loss of the latter removes the "governor" regulating the development of the plant. It is believed, however, that the increase in the number of flowers produced on the plants in the paired rows

indicates that some economic advantage may be gained by using this method on rich alluvial soils. Growers with such soils in the districts where heavy rainfall may be experienced in February, and again in April when the lower bolls are nearly matured, should experiment with the method. The losses which have occurred under such conditions during the last two seasons warrant a very careful study being made of the suitability of the paired rows, as it is possible that while no greater crop will be produced a much higher proportion may be saved than where the rows are regularly spaced the usual $4\frac{1}{2}$ feet.

*Hill versus Drill Planting Experiment.*—The merits of planting cotton in hills wide enough apart to allow of cross-cultivation, as compared with the usual method of planting in drills and later thinning out the plants to a distance of 2 feet apart, is of especial interest in a season like that just completed. In the previous season the experiment on this subject was planted early and gave promise of yielding some interesting information. Unfortunately, through a misunderstanding at harvesting time, the plot was picked in such a manner as to make the yields obtained of little value. The flower counts of that experiment clearly indicated, however, the yielding possibilities of the two systems. During the first 12 days of the flowering period which commenced on the 19th December, the single plants in the hills which were spaced $3\frac{1}{2}$ ft. apart in rows $4\frac{1}{2}$ ft. apart produced only 58·3% as many flowers as did the 2 ft. spaced single plants in the same row spacing. During January the wider spaced plants gained somewhat, but still produced only 73·4% as many flowers as did the other treatment. The wet conditions in February accelerated the growth of the larger plants, however, with the result that they produced about the same number of flowers as did the 2 ft. spaced plants. The flowering in the wider spaced plants fell off after this, only 94·% as many flowers being produced in March as in the closer spacing.

The experiment of this season was planted 32 days later than was that of last season. This caused a delay in the start of general flowering until the 21st of January as compared with the 19th December in the previous experiment. The wide spaced plants did not produce as many flowers as those more closely spaced in any of the three months in which the observations were taken. The numbers of flowers of the wide spaced plants expressed as percentages of the 2 ft. spaced plants were as follows :—January, 47·3%, February, 72·0%, March, 70·2%. These compare with the following percentages for the preceeding season :—January, 73·4%, February, 101%, March, 94·8%. It would appear, therefore, that with a $3\frac{1}{2}$ ft. spacing between the plants there were

fewer flowers per given area of row than with the 2 ft. spacing. It would also appear for the two seasons under review that when the crop is planted late and experiences a wet season, the difference in flower production between the two spacings is all the more pronounced.

Owing to the severe maize grub attacks which were experienced in this section of the Station, the yields were so low that no reliable data could be obtained from them. A portion of the plots was picked, however, where sufficient cotton was present to afford some idea of the yielding abilities of the spacings, but simply as a bulk picking of 6 short rows of a total area of approximately one-eighth of an acre of each treatment. It is recognised that such data are of little value; but the fact that in these two plots the 2 ft. spacing gave 100% heavier yield, (at the rate of 832 lbs. per acre as compared with 416 lbs.), would indicate that probably the closer spacing would have produced at a heavier rate over the whole of the experiment but for the maize grub attack.

In order to afford material for an examination of the effect of the spacings on the individual plant, 30 plants were selected, in the manner previously described, in each treatment in the plots which were harvested.

Table I records the data obtained from the material collected.

TABLE I.

DATA REFERRING TO BOLL FORMATION AND WEIGHT OF BOLLS (GRAMMES) IN HILL VERSUS DRILL PLANTING EXPERIMENT.

| | *DRILL* | | | | *HILL* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Mean* | *P.E.* | *S.D.* | *P.E.* | *Mean* | *P.E.* | *S.D.* | *P.E.* |
| No. of 5-Locked ... Bolls | 4·8 | ±·35 | 2·82 | ±·25 | 5·27 | ±·35 | 2·82 | ±·25 |
| No. of 4-Locked Bolls | 6·4 | ±·47 | 3·8 | ±·33 | 6·03 | ±·40 | 3·27 | ±·28 |
| Green 5's ... ... | 0·53 | ±·09 | 0·72 | ±·06 | 1·13 | ±·20 | 1·65 | ±·14 |
| Green 4's ... ... | 7·6 | ±·70 | 5·7 | ±·50 | 6·6 | ±·60 | 4·54 | ±·40 |
| Total no. of Bolls | 24·47 | ±1·02 | 8·32 | ±·72 | 23·87 | ±1·24 | 10·06 | ±·88 |
| Total seed cotton per plant | 91·28 | ±4·34 | 35·21 | ±3·07 | 85·99 | ±3·39 | 38·88 | ±4·79 |
| No. of Bolls per lb. seed cotton | 72·75 | ±1·62 | 13·19 | ±1·15 | 75·33 | ±1·07 | 8·68 | ±·76 |
| Average weight 5-Locked Bolls | 6·94 | ±·12 | ·92 | ±·08 | 6·59 | ±·11 | ·92 | ±·08 |
| Average weight 4-Locked Bolls | 6·07 | ±·12 | ·92 | ±·08 | 5·36 | ±·20 | 1·59 | ±·14 |
| Difference between average weight 5 & 4 Locked Bolls = 0·87 ±·17 grammes. $\frac{D}{E}$ = 5·1. | | | | | Difference between average weight 5 & 4 Locked Bolls = 1·23 ±·23 grammes. $\frac{D}{E}$ = 5·35 | | | |

The data would indicate that there was no significant difference between the two spacings in any of the plant characters examined. In each treatment, however, the average weight of a 5-locked boll was significantly greater than that of the 4-locked boll. The difference was greater in the hill spacing, but this may have been caused by the considerably higher variation between the plants in this treatment, the coefficient of variability being approximately twice that in the drill spacing.

The notes taken during the growth of the experiment indicate that the plants in the hill treatment had a heavier vegetative development and tended more to lodge. This latter feature was present last season both in a similar experiment and in one in which different numbers of plants were left in hills spaced 3½ ft. apart. This tendency to lodge prevents close working to the plants in the later cultivations and thereby defeats the purpose for which the wide spacing is intended. Based on the results obtained for the two seasons, it would appear questionable if there is any advantage to be gained by such wide spacing of the plants, so far as cultivation is concerned, and it may be possible that lighter yields will be obtained if this practice is followed.

*Thinning and Spacing Experiment.*—The experiment of this season was similar to that of last season in that plant spacings 12, 24 and 36 inches apart, thinned when 6–8 inches high, were compared in rows spaced 4, 4½, and 5 feet apart. The irregularity in the rate of germination following the 8th November planting, and of the stands obtained, however, prevent any confidence being placed in the yields. Only the observations on plant growth and the flower counts will accordingly be discussed.

(*i*) *Four-foot row spacing.*—Generally speaking, the plants spaced 12 inches apart showed the effect of the different heat waves more than either the 24-or 36-inch spacings. This resulted in an early loss of the bottom crop of squares and later of young bolls, earlier flowering, and earlier maturing of the whole crop. The 36-inch spacing gave the most promise of yielding a profitable crop, but owing to the rank vegetative growth a large proportion was lost through the early killing frosts.

(*ii*) *Four-and-a-half-foot row spacing.*—The 12-inch plant spacing in this row width was also the most susceptible to heat waves and dry conditions. Not only was there a tendency to shed the bottom crop, but the plants were also checked in their growth during the major part of the season. The 24-inch spacing, as in the 4-foot row width plots, appeared to be at a disadvantage in that the plants were not close enough to be checked in their development and not wide enough to

prevent over-crowding of their somewhat vegetative growth. The 36-inch spacing again gave excellent promise, but vigorous growth delayed the boll opening, with the result that much damage was done by the early frosts.

(*iii*) *Five-foot row spacing.*—The more closely spaced plants developed along similar lines to those in the other two row width treatments. The 24-inch spacing was even more vegetative than in the plots with the rows 4½ ft. apart. The 36-inch spacing gave the impression that it would have produced the heaviest yield but for the early frosts.

In order to obtain as much information on the production of flowers as was practicable, the best spaced row of the inner three rows in each of the five plots of each treatment was selected for daily flower counts. The following table, therefore, sets out the data obtained from the totals of the daily means of five 100 ft. row lengths in each treatment.

TABLE II.

Flower counts from Thinning and Spacing Experiment.

| *Treatment.* | *30th Jan. to 28th Feb.* | *% of total.* | *% with 1ft. spacing as 100.* | *Rest of season to 5th April.* | *Actual Total.* | *% with 1ft. spacing as 100.* | *Corrected total to equal 4½ ft. row spacing.* | *% of each total based on 12" spacing in 4ft. rows as 100.* |
|---|---|---|---|---|---|---|---|---|
| *4 ft. rows.* | | | | | | | | |
| Plants 12 ins. ... | 1,153 | 63 | 100 | 680 | 1,833 | 100 | 2,062 | 100 |
| „ 24 „ ... | 836 | 52 | 72 | 786 | 1,622 | 89 | 1,825 | 89 |
| „ 36 „ ... | 579 | 45 | 50 | 716 | 1,295 | 71 | 1,457 | 71 |
| *4½ ft. rows.* | | | | | | | | |
| Plants 12 ins. ... | 1,063 | 57 | 100 | 787 | 1,850 | 100 | 1,850 | 90 |
| „ 24 „ ... | 1,016 | 56 | 96 | 784 | 1,800 | 97 | 1,800 | 87 |
| „ 36 „ ... | 791 | 51 | 74 | 753 | 1,544 | 84 | 1,544 | 75 |
| *5 ft. rows.* | | | | | | | | |
| Plants 12 ins. ... | 920 | 52 | 100 | 845 | 1,765 | 100 | 1,589 | 77 |
| „ 24 „ ... | 867 | 50 | 94 | 877 | 1,744 | 99 | 1,570 | 76 |
| „ 36 „ ... | 686 | 45 | 75 | 828 | 1,514 | 86 | 1,363 | 66 |

The data indicate that on the plants examined there was an advantage in favour of the closer spaced plants in each row treatment. This may be due to the effects of the heat wave during January, forcing the closer spaced plants into earlier flowering. The counts for the thirty days following this heat wave show that a higher percentage of the total number of flowers for the season in each treatment was produced in the 1-foot spacing in all three row widths, and that the actual number of flowers per row decreased as the rows widened. The decrease in percentage of the total between the 2- and 3-ft. spacings

in each row width was of the same order, but in the actual number of flowers during this period, the wider row widths had more than the 4-ft. rows, with the 4½-ft. rows having the highest. The data for the total flowers for the season were corrected to make the area of the 4- and 5-ft. rows the same area as that of the 4½-ft. rows, which is the usual row spacing in most of the Queensland cotton districts. The corrected totals indicate that the 12-inch spacing in the 4-ft. rows produced the greatest number of flowers. There was little difference between the 24-inch spacing in the 4-ft. rows, and the 12- and 24-inch spacings in the 4½-ft. rows. The 36-inch plant spacings in all three row widths were the lowest. As has been pointed out, these results are in keeping with the plant development in the different treatments. It must not be understood, however, that the yields were necessarily of the same order. The conditions which hastened the early production of flowers were really of the most benefit to the wider spaced plants in the wider spaced rows, in that they tended to harden up the plant growth in these spacings, while in the closer spacing a decided check occurred. It is possible that had the April rains been of less amount the value of this hardening up of the plants in the wider spacings would have been demonstrated in that a quicker maturing of the bolls would have been obtained. This would have resulted in a larger crop being opened before the frosts occurred, and also would have dried out the upper bolls sufficiently to have prevented them from being frozen to the point where they were worthless.

*Height of Thinning Experiment.*—This experiment was planted following on the rain of the 8th November, but unfortunately suffered a variable germination in common with the rest of the plantings at this date. The yields, therefore, are of little value, although those obtained from two " Latin Squares " of this experiment indicated that the latest thinning produced the lowest yield. The variation in age of the plants makes the yields unreliable, however, so only the flowering data and the material from 60 selected plants in each treatment will be considered. The plants were selected by the method previously described, so it is believed that the results are truly representative of the three treatments under the conditions in which they were grown.

The thinnings were performed when the plants were 6–8, 10–12, and 14–16 inches high, to a distance of 24 inches apart, one plant to a hole. Observations on the 24th January gave the impression that little difference existed between the two earlier thinnings, but the effect of the delayed thinning during the favourable growing conditions in December had given the 14–16 inch thinning a decided " spindly " appearance, with practically no bottom crop. The effect of the

prolonged high temperatures and lack of rain was noticeable in all three treatments, the fruiting branches produced during that period showing a decided shortening of length of internodes as compared with the rather long internodes produced during the luxuriant growing conditions. Owing to the variation in stand and the loss of terminals from a hail storm it was believed that the usual flower counts in the centre rows of each plot would be of little value. In an effort to obtain as much information as possible on this factor, it was decided, therefore, to select 20 plants in each plot of each treatment by the same method as was used in selecting the plants from which to obtain material for boll weight determinations, etc. Accordingly, daily flower counts were made on 120 plants in each treatment, and the following data were obtained :—

TABLE III.

Flower Counts of Height of Thinning Experiment.

| *Treatment height.* | *30th Jan. to 28th Feb.* | *Per cent of total.* | *Rest of season to 4th April.* | *Total* | *Percentage based on 6–8″ thinning as 100.* |
|---|---|---|---|---|---|
| 6—8″ ... | 3,147 | 61·5 | 1,979 | 5,126 | 100 |
| 10—12″ ... | 2,641 | 56·3 | 2,049 | 4,690 | 91·5 |
| 14—16″ ... | 2,129 | 53·5 | 1,851 | 3,980 | 77·8 |

It would appear that, as was the case last season, the earliest thinning was conducive to an early formation of the fruiting branches and thus of a heavier production of flowers during the first period of flowering. In the previous season, however, this advantage was lost, as the later thinnings produced higher total numbers of flowers for the season. The explanation of such a result appeared to lie in the fact that under the favourable seasonal conditions during the early growth of the plants, a rather vegetative development occurred in the early thinned plots. Considerable shedding of squares took place on this growth during unfavourable conditions in January and February, which thereby reduced the later flowering. There was a tendency to produce flowers in a somewhat similar manner this season, but the flowering season being so much later than in the experiment of last year, the later thinned plants could not overcome the initial advantage of the early thinned ones.

The data obtained from the boll material collected from the 60 selected plants in each treatment can best be summarized in the manner set out in the accompanying table :—

TABLE IV.

Boll Data for Height of Thinning Experiment.

| | | | |
|---|---|---|---|
| Total No. of bolls per plant. | Most on the earliest thinning—least on latest one.<br>Differences not significant statistically. | | |
| No. of bolls per lb. of cotton. | Differences irregular.<br>Differences not significant statistically. | | |
| Harvested bolls expressed as % of total crop per plant for each treatment | 6–8″, thinning=55·7 per cent.<br>10–12″, thinning=54 per cent.<br>14–16″, thinning=47·3 per cent. | | |
| Average weight seed cotton per plant. | Most on the earliest thinning—least on latest.<br>Difference between 6–8″ and 10–12″ treatment, not significant, $\frac{D}{E}$ = 1·43.<br>Difference between 6–8″ and 14–16″ treatment, significant, $\frac{D}{E}$ = 4·10.<br>Difference between 10–12″ and 14–16″ treatment, not significant, $\frac{D}{E}$ = 2·47. | | |
| Difference in number of 5- and 4-locked bolls per plant harvested in each treatment. | 6–8″ treatment slight tendency for more 5's, not significant.<br>10–12″ treatment—greater tendency for more 4's, $\frac{D}{E}$=2·39.<br>14–16″ treatment—significant tendency for more 4's $\frac{D}{E}$= 5. | | |
| Difference in number of 5- and 4-locked green bolls per plant unharvested. | 6–8″ treatment—Highly significant in favour of 4-locked. | $\frac{D}{E}$=9·26 | 27% 5-locked. |
| | 10–12″ treatment—Highly significant in favour of 4-locked. | $\frac{D}{E}$=10·7 | 22% 5-locked. |
| | 14–16″ treatment—Highly significant in favour of 4-locked. | $\frac{D}{E}$=11·· | 25% 5-locked. |
| Difference in average weight of 5- and 4-locked bolls per plant. | 6–8″ treatment—Highly significant in favour of 5's. | $\frac{D}{E}$=9·43 | 4's, 83% as heavy. |
| | 10–12″ treatment—Very significant in favour of 5's. | $\frac{D}{E}$=6·95 | 4's, 83% as heavy. |
| | 14–16″ treatment—Highly significant in favour of 5's. | $\frac{D}{E}$=9·15 | 4's, 83% as heavy. |
| Average number of 5-locked bolls expressed as percentage of the average total no. of bolls per plant. | 6–8″ treatment. 26·9 per cent.<br>10–12″ treatment 20·9 per cent.<br>14–16″ treatment 20· per cent. | | |

It would appear from the above data that under the conditions governing the experiment, the earliest thinning gave the following advantages :— a few more bolls per plant, a slightly larger percentage matured by time of first frosts, slightly more seed cotton than in the 10–12 inch thinning, and significantly more than in the 14–16 inch thinning, a higher percentage of 5-locked bolls in the total number of bolls borne per plant, and a higher percentage of 5-locked bolls in the bolls harvested. The results would indicate, therefore, that the heavier rate of flowering observed in the earlier thinnings during the first period of flower counting was apparently to the advantage of these thinnings in that a better yield was obtained by the time of the first killing frosts. This advantage in yield can be explained by the facts that not only was there a higher percentage of bolls matured, but there was also a greater percentage of 5-locked bolls in the crop harvested. As the 4-locked bolls weighed only 83% as much as the 5's, it can be seen that this would materially influence the yield. The results are different in some respects from those obtained last season in the same experiment. Then, the total number of harvested bolls per plant was in favour of the later thinnings. The number of 5-locked bolls per plant averaged about the same in each treatment, but there was a significant difference against the 6–8 inch height of thinning in the number of 4-locked bolls per plant between the 6–8 inch and 10–12 inch treatments ($\frac{D}{E}$=3·85), and between the 6–8 inch and 14–16 inch treatments ($\frac{D}{E}$=4·4), and barely a significant difference in favour of the 14–16 inch thinning as compared with the 10–12 inch treatment ($\frac{D}{E}$=3·05). The percentage of 5-locked bolls of the total number of bolls harvested per plant in each treatment was somewhat of the same order as in this season, with the exception that the 10–12 inch treatment had a higher percentage of such bolls than did the 6–8 inch (the figures are 6–8 inch—27·9% ; 10–12 inch—30·4% ; and 14–16 inch—25·8%). There was not such a range between the treatments as was the case this season.

The results obtained from the experiment for the last two seasons indicate that thinning when the plants are 6–8 inches in height is conducive to the early development of the fruiting branch structure. This allows of the earlier production of flowers, and gives this height of thinning an advantage over the other heights tried. In a late planted crop this is of decided value, as a larger number of bolls will be harvested if early frosts occur. Apparently, in a late planted crop, there is a

higher percentage of 5-locked bolls developed in the earlier maturing bolls of the 6–8 inch thinning than in either of the other two treatments. As the weight of the 4-locked bolls in the late planted experiment of this season averaged around 83% of the weight of the 5-locked, and from 84% to 90% in early planted plots of the previous season, it would appear that this greater percentage of 5-locked bolls in the earlier formed bolls is of decided advantage, especially in a short season.

*Fertilizer Top Dressing Experiments.*—The fertilizer experiments conducted on the Research Station during the previous seasons have been in the nature of tests of different combinations of manures which were put in the ground just prior to planting. No results have been obtained, either in visible plant development or yields, which would indicate that any of the fertilizers have been of value to the plants. The same results were also obtained in the tests conducted with grower co-operators in the various cotton-growing districts of the State. The explanation of such a phenomenon may lie in the climatic conditions existing during the early stages of the seasons. Usually the soils have only a very low percentage of moisture in the upper six inches prior to the planting rains. Frequently the plantings are accomplished through storms which barely penetrate a sufficient depth to enable the tap roots of the seedlings to reach into what moisture there is in the upper subsoils. No further rains of any amount may occur for three or four weeks after the planting storms and, as the maximum temperatures may be very high then, there is considerable evaporation. Under such conditions the manures may not be made available to the plants in sufficient quantities to be of much assistance during their early period of development. Consequently, when the heavy wet season does occur, the leaching of the remaining portions of the manures is so rapid that the total value of the manures has been of little benefit to the plants.

It was decided, therefore, to test the value of different manures as top dressings applied when the rains occurred in sufficient quantity to insure that the conditions would be favourable to plant growth and action on the manures. Such conditions usually occur when the plants have been thinned and have started the development of the lower fruiting structure. With early planted cotton, this period would ordinarily be when the plants are about 12 inches in height and carrying a few squares. Preliminary trials indicated the possibility of certain manures having an effect on the plants when applied under the above described conditions. Accordingly, during this past season further studies were made in the manures which gave the most promise in the preliminary trials.

The results obtained this season are of little value as regards yields owing to the plots being planted late and having suffered from excess vegetation and corn-ear worm attacks. The early development of the plants is interesting, however, as it clearly showed the value of nitrate of soda as a stimulus to early plant growth and square and flower production. On the other hand, muriate of potash appeared to retard plant growth. In other similar tests in earlier planted cotton under irrigation, the difference in plant growth between these two treatments was decidedly pronounced, the plants in the plots treated with nitrate of soda exhibiting a tendency to elongated internodes on both the main stalk and fruiting branches. The plants in the plots treated with muriate of potash were, in contrast, of shorter structure and with a more compact development of fruiting branches.

The flower counts in the experiment on the Research Station gave the following results :—

TABLE V.

FLOWER COUNTS IN FERTILIZER TOP DRESSING EXPERIMENT, EXPRESSED IN PERCENTAGES. (MEANS OF FIVE 100 FT. ROW LENGTHS).

| *Treatment (per acre basis).* | *1st fortnight (14-28th Feb.) Percentage of whole season.* | *Rest of Season with Nitrate of Soda treatment as 100%* |
|---|---|---|
| 1 cwt. Nitrate of Soda ... | 58 | 100 |
| 1 cwt. Nitrate of Soda + 2 cwt. Muriate of Potash | 42·8 | 97·5 |
| Untreated, control ... | 41·3 | 97·5 |
| 2 cwt. Muriate of potash ... | 41 | 94·6 |

The results of the flower counts are particularly interesting from a standpoint of Queensland conditions on account of the irregularity of the seasons. It is possible that further investigations with the manures used in this test, may show that the problem of controlling rank growth under heavy rainfall conditions may be solved.

## COTTON BREEDING.

*Progeny Block.*—The seasonal conditions so badly affected the plant growth in the progeny block that no studies of any value could be performed. The progenies are, therefore, being replanted for comparison during the coming season along with a few selections made in them this season.

*Seed Increase Plots.*—The plants in these plots were also of such excessive growth that a careful inspection of their uniformity was not warranted. The breeding work was therefore confined to inspecting plants of promising appearance for possible material to be included

in the progeny block of the coming season. Several plants were obtained which had excellent lint characters, the strength of the fibres being easily the best ever produced on the Station. As some of the progenies showed up similarly in this respect, it is believed that progress is being made in this very important factor.

Considerable time was also spent in selecting new material in commercial fields where more normal conditions existed. Several very fine plants were obtained which will be tested out in the progeny blocks on the Station.

### Insect Problems.

Insect pests affected the yields obtained on the Station this season more than has been the case in any previous crop. The outstanding one was the Corn-ear worm which completely destroyed the top crop of squares on all the late planted cotton. Other insects present, and causing varying amounts of damage, were thrips, pink boll worm, rough boll worm, and the sucking bugs.

*Thrips* (*Thrips tabaci* Lind.).—This insect was present during the early stages of the plant growth and caused serious loss of terminals in many of the November planted plots. It was also present in the December planted plots, but to a much less degree. As in previous seasons, the presence of this insect after November appears to be correlated with the amount of rainfall. Under good rainfall there is but light infection in December, but when the precipitation is scanty in this month damage may be done even on plants a foot or more high.

*Cutworms* (*Euxoa radians* Guen.).—Owing to the fact that there was no cotton planted on the Station in either September or October, it cannot be stated if cutworms were present during this past spring. No reports were received of serious damage in the immediate district where October planting was obtained, so it is not believed that this pest was present in sufficient numbers to be of economic importance.

*Corn-ear Worm* (*Heliothis obsoleta* Fabr.).—The Station suffered from attacks by this pest more than in any year since it has been established. The explanation appears to lie purely in the fact that all the plots were late planted. The experiences of previous seasons have all demonstrated that late-planted crops on the Station soils are liable to attacks from the corn-ear worm. The conditions during this past season have been eminently suitable for heavy occurrence of this pest, and the losses experienced were to be expected. Each season supplies evidence that damage from corn-ear worms is very closely correlated with late-planted crops on rich alluvial loamy soils. Exceptions occur, of course, but generally speaking, this is true. Late-planted crops on

clay soils, however, appear to be free from attack to an amazing extent. The explanation appears to lie in the nature of the plant growth. On rich alluvial loams the late-sown plants make a rapid, sappy, vegetative growth if the climatic conditions are at all favourable. On clayey soils, crops planted at the same time and receiving similar rainfall usually make a much slower and tougher growth which apparently is not attractive to this insect.

The lucerne plot on the Station was again the source of an invasion from the corn-ear worm. On the 31st January a migration of grubs similar to that of last season crossed the 18-foot roadway into E. block. This followed a rapid drying-off and wilting of the lucerne. Bran, Paris green, and molasses bait was scattered down the road, and in the cotton rows at right angles to the road the plants for a distance of a chain were hand picked of all larvæ. The measures taken were entirely successful. The emergence of moths responsible for this brood commenced following the 2·55 points of rain on the 4th and 5th December.

*Pink Boll Worm* (*Platyedra gossypiella*, Saunders).—The light yields caused by the late planting and heavy corn-ear worm attacks prevented an examination of any value from being made in the plot which is annually examined for pink boll worm. It was thought advisable, however, to attempt to obtain some data regarding the presence of this insect this season. Accordingly, 200 bolls were examined in a plot in the same portion of the field and only one worm was found. This was not a comparable test to that of the previous season, so no significance can be attached to the result. An isolated progeny increase planting in the orchard plot on top of the hill was also examined. This plot was adjacent to soft vine scrub and lay in line between the location of the first cotton plot in the district, and the bulk of the Station plots. As it is thought that the site of the first crop might be the original source of infection for the district, it was thought that the progeny plot might show results of interest.

The material used for this examination was off-type plants which had been pulled up in the breeding operations. Ninety plants were taken, which came from all parts of the plot, which was about one-third of an acre in area. A total of 1,798 ripe and 2,658 green bolls were examined on those plants and the following numbers of pests obtained—Pink boll worm, 90 ; rough boll worm (*Earias huegeli*), 28 ; and Peach or sometimes called Maize-grub (*Conogethes punctiferalis* Gn.), 21. The number of pink boll worms does not imply that percentage of boll infestation, however, as several bolls contained 2 worms, and three bolls 3 worms. Unfortunately, the records were not taken so as to

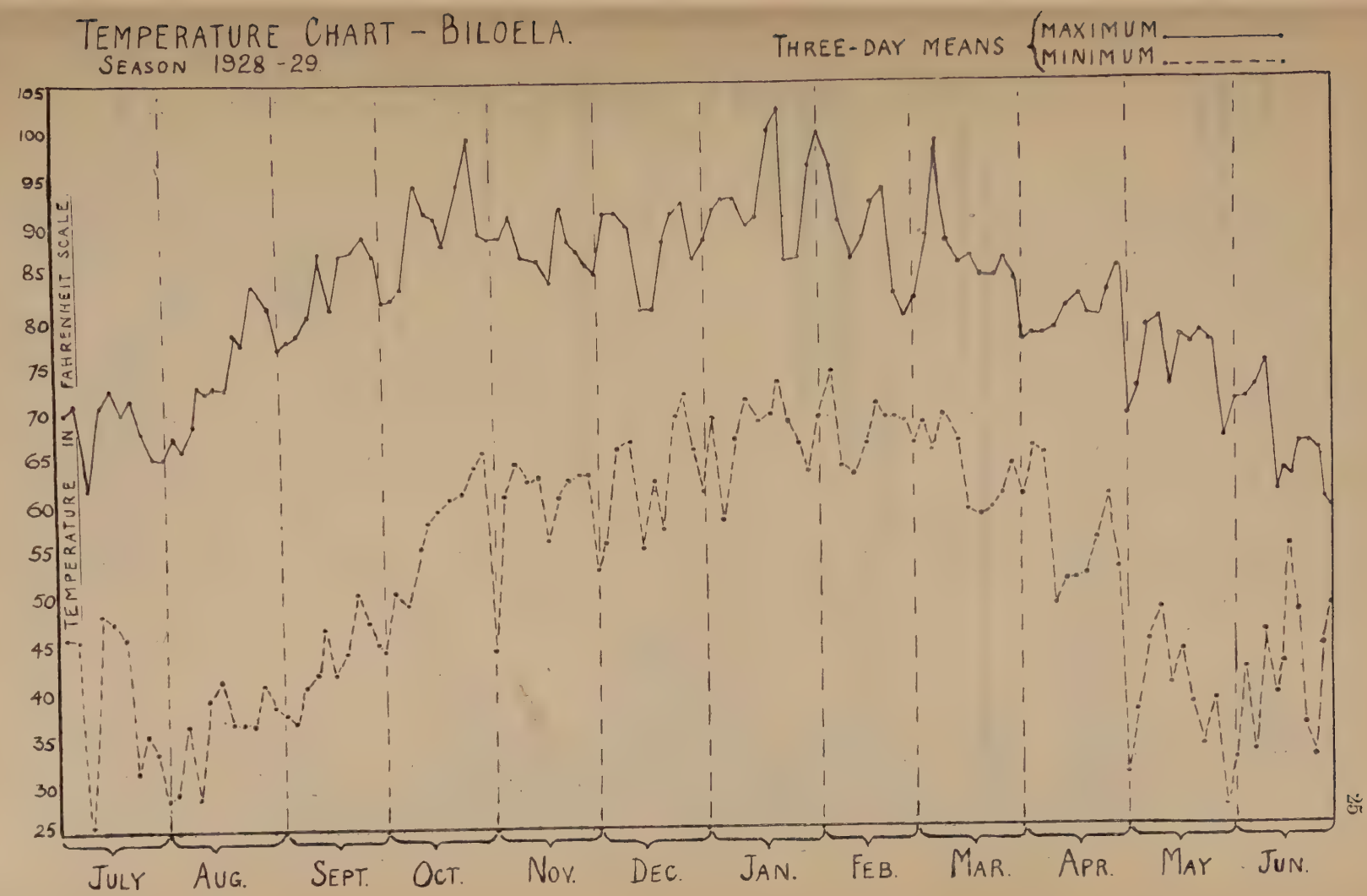
give the actual percentage of attacked bolls. Of the ninety plants examined twenty-five did not have a pink boll worm.

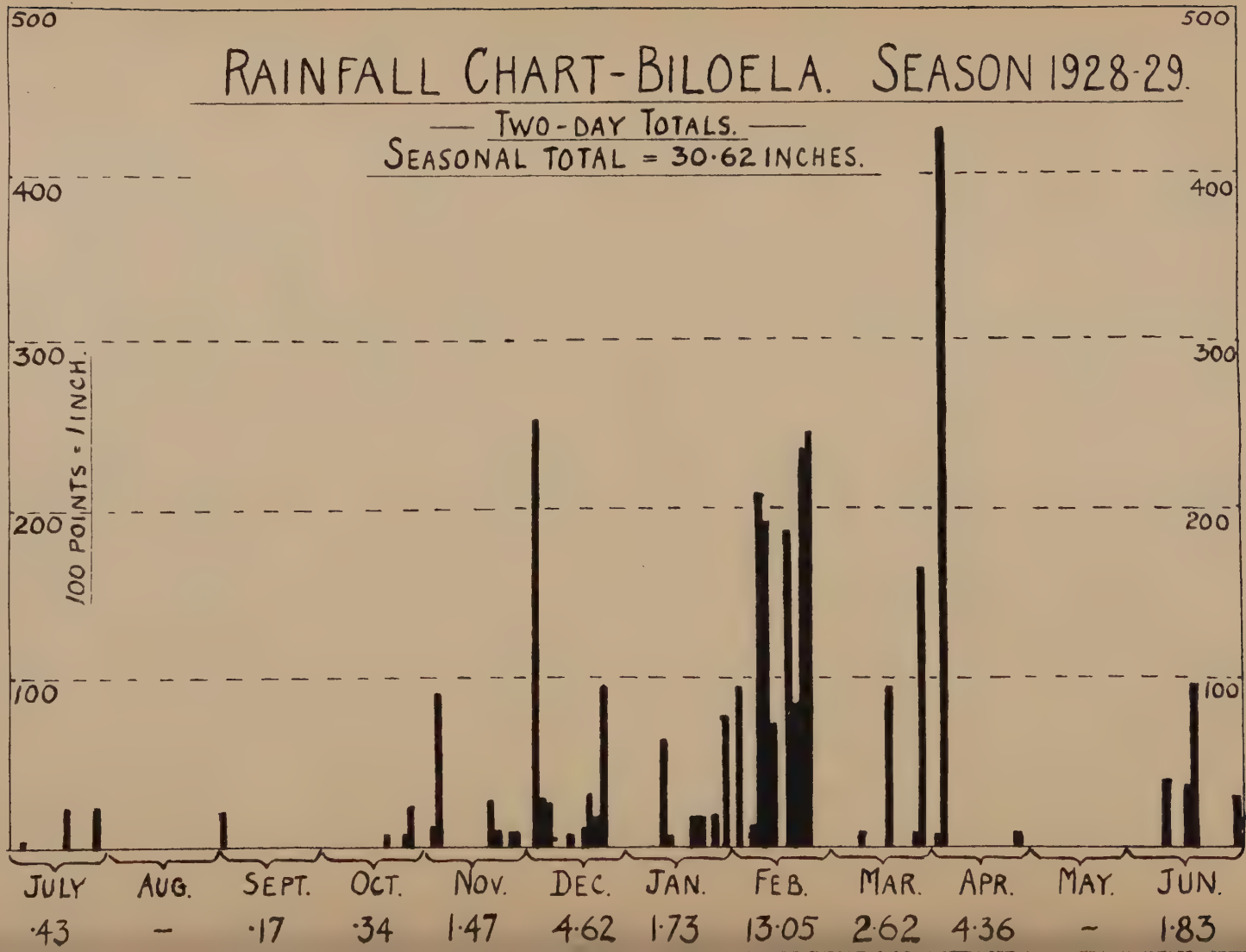
The results obtained in this inspection made it appear desirable to examine a crop in some other portion of the district. Accordingly, a field in the centre of an alluvial flat and some 12 miles from the Station was examined. Unfortunately, it was late in the season and only the green bolls of the upper part of the plants were available. The material is therefore hardly comparable with that obtained in the Station plot. The procedure adopted here was to select scattered well-laden plants over the field which covered approximately 10 acres. As in the orchard plot on the Station, every boll was taken off each selected plant and thoroughly examined. A total of 2,300 bolls were inspected in this manner and the following worms found :—Pink boll worm, 45 ; rough boll worm, 18 ; peach grub, none. Seventy-two plants were examined and thirty-six did not have a pink boll worm in the green bolls. It would appear, therefore, that the population of pink boll worms is not a serious economic factor in the Callide Valley, at present. The presence of so many in a small plot near the soft wood scrub indicates, however, that very careful methods of cleaning up the cotton crop should be exercised at the end of each season. This clean up should be performed as early as possible, as many of the larvæ were found in the old diseased bolls and an early destruction of the plants would have killed most of them.

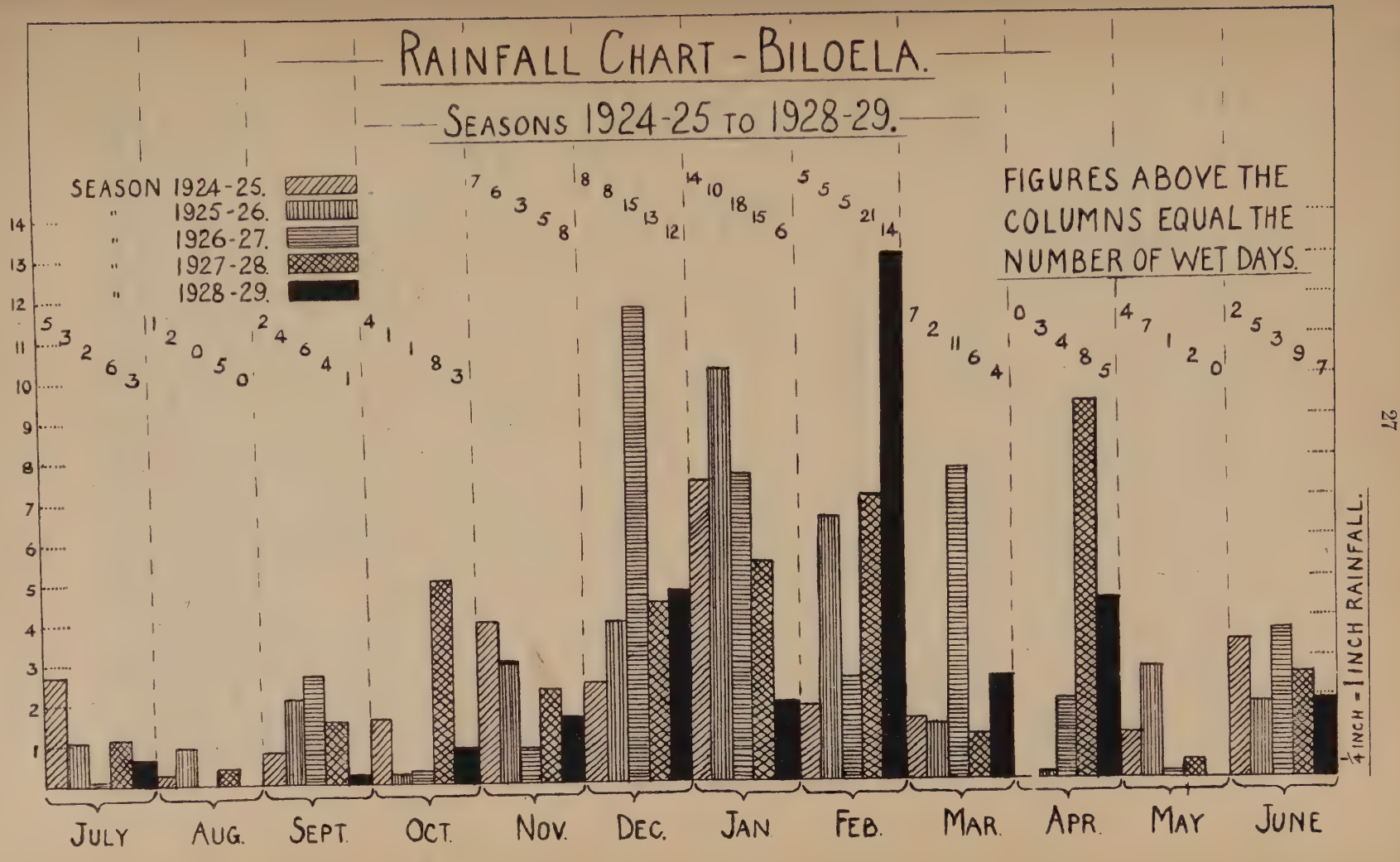
*Sucking Bugs.*—The False Stainer (*Aulacosternum nigrorubrum* Dall.) was present in larger numbers throughout most of the season, than has ever been the case in previous crops on the Station. In fact, it was in as large numbers during the latter part of the season as was *Dysdercus sidæ*. It may be possible, therefore, that it is responsible for some of the punctures which in the past have been ascribed to *Dysdercus* and *Tectacoris lineola*. The fact that it occurs in large numbers during the squaring season when there are practically no bolls on the plants may also indicate that it is responsible for some of the square shedding, or, possibly, for the peculiar late loss of terminals which has been experienced in the last three seasons.

The Harlequin Bug (*Tectacoris lineola* F.) was not seen until the 3rd February. Shortly afterwards, small numbers of both sexes were seen and a few clusters of egg colonies were found. This insect was hardly noticeable during the rest of the season and was in even fewer numbers than in the previous season.

The large and small stainers (*Dysdercus sidæ* Montr. and *Oxycarenus luctuosus* Montr.) were present, but in light numbers.


TEMPERATURE CHART - BILOELA.
SEASON 1928-29.
THREE-DAY MEANS {MAXIMUM MINIMUM
TEMPERATURE IN FAHRENHEIT SCALE.
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUN.


RAINFALL CHART - BILOELA. SEASON 1928-29.
— TWO-DAY TOTALS. —
SEASONAL TOTAL = 30·62 INCHES.
500
400
300
200
100
100 POINTS = 1 INCH.
JULY ·43
AUG. –
SEPT. ·17
OCT. ·34
NOV. 1·47
DEC. 4·62
JAN. 1·73
FEB. 13·05
MAR. 2·62
APR. 4·36
MAY. –
JUN. 1·83


RAINFALL CHART - BILOELA.
SEASONS 1924-25 TO 1928-29.
SEASON 1924-25.
" 1925-26.
" 1926-27.
" 1927-28.
" 1928-29.
FIGURES ABOVE THE COLUMNS EQUAL THE NUMBER OF WET DAYS.
5 3 2 6 3
11 2 0 5 0
2 4 6 4 1
4 1 1 8 3
7 6 3 5 8
8 8 15 13 12
14 10 18 15 6
5 5 5 21 14
7 2 11 6 4
0 3 4 8 5
4 7 1 2 0
2 5 3 9 7
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
1/4 INCH = 1 INCH RAINFALL.

# SOUTH AFRICA

## REPORT OF THE CORPORATION'S WORK AT THE STATIONS AT BARBERTON, TRANSVAAL, CANDOVER ESTATES, NATAL, AND IN SWAZILAND, FOR THE SEASON 1928-29.

INTRODUCTORY NOTE BY MR. S. MILLIGAN.

OWING to the extreme lateness of the past season, and the short time available between reaping and the planting of the new crop, the reports of the "low veld" cotton Stations are not so complete as they would otherwise have been.

For the sake of those who have not followed the work on these Stations from the beginning, an explanation with regard to the names and origin of the varieties now under test at these Stations appears advisable.

The breeding of strains for low veld conditions was entrusted to the Corporation by the Union Government in 1924 and after a season's experience it became evident that the combination of the jassid and bollworm pests was a very serious menace to cotton growers in this important area. An attempt was, therefore, made to deal with the former through plant selection. During the 1924-25 Season the progeny of a single plant, one out of a number picked at random from some late cotton in Zululand after the real picking season was over, showed good resistance to jassid and continued to breed true to this character. This strain is the Z.1 mentioned in the reports. It possessed no appreciably valuable characters apart from jassid resistance, but the jassid situation in the districts was so menacing that its multiplication with a view to seed distribution appeared advisable. Seed for about 20,000 acres was distributed to cotton growers in the year 1928. Meanwhile the progeny of single plants selected by Mr. Parnell from three of the local varieties, Improved Bancroft, Uganda and Zululand Hybrid, were being tested at the Barberton Station. Many of these proved jassid-resistant, but a severe drought in the year 1926-27 assisted in reducing them to two very desirable strains, U.4 and A.12. U.4 is the progeny of a single plant selected on the Station in 1925 by Mr. Parnell from the mixture which is known in the Union under the name of "Uganda," presumably because the seed originally came from that country. A.12 is a selection made by Mr. Andrews, a well-known cotton grower in Barberton, with the assistance of Mr. Parnell, from "Improved

Bancroft." Both these strains showed great drought resistance in the season referred to, and it was pretty obvious that either one or the other would be the successor of Z.1 in the districts. Variety tests, therefore, for the last two seasons have been more or less confined to comparisons between Z.1, U.4 and A.12. Results in the season 1927-28 showed that while A.12 marked an improvement on Z.1 in yield and most other qualities, it was in turn surpassed by U.4 in yield to the extent of 40%. The results of the past season confirm this. U.4 has been so satisfactory that it has been decided to restrict selections for the immediate future to this strain. It is indeed a remarkable strain, possessing, in addition to jassid-resisting qualities, drought resistance, prolific flowering capacity, quickness in forming buds and setting fruit, freedom from shedding, and in the bulk, which is far from being uniform, a large number of individuals with excellent lint characters and high ginning percentage.

As mentioned in last year's Report, it has done well in Rhodesia and seems likely to form the parent variety for selection in that country. With the great possibilities of immediate results from a distribution of seed from U.4 in the districts, the greater part of the time of the staff of the Corporation has been devoted to work on this strain, making and multiplying re-selections from it and subjecting them to a close examination at Barberton. The additions to the staff have largely assisted in making this examination very thorough. It has, in fact, made it possible to issue the seed to growers with every confidence that it is by far the most suitable for average conditions in the low veld.

District multiplication began in the previous season (1927-28) with some 30 acres in small patches under widely varying soil and climatic conditions. Uniformly good results were obtained, fully confirming the experience of U.4 at the Barberton Station, the high yields assisting greatly the rate of propagation. In spite of late rains and early drought, over 1,200 acres were planted in the past season. Even better results were obtained. The strain, selected for general hardiness and jassid resistance, showed remarkable cropping properties when under really good conditions, yields of 1,000 to 1,500 lbs. of seed cotton per acre being not uncommon (in a few cases it approached and even exceeded 2,000 lbs. on small patches). Remarkable retention of buds and bolls during and after drought, and quick recovery from bollworm attack were amongst the more obvious qualities displayed, characters which are of the utmost value in a variable climate.

Outside multiplications yielded nearly 300 tons (600,000 lbs.) of bulk or non-selected seed, sufficient to plant about 30,000 acres at the

usual rate of 20 lbs. per acre. Re-selection has been carried out steadily from the outset, the one serious setback being damage by hail in the season 1927-28. Satisfactory improvement has been made, as may be seen from a perusal of Mr. Parnell's report, two re-selections out of the original six showing a distinct advance over the bulk lot. Two of the types re-selected on the other hand showed a " significant decrease " in yield on the mixed bulk. The yield figures given are an object lesson, if such were necessary, of the importance of such work being carried out under skilled supervision.

Insect pests were not much in evidence during the past season at any of the Stations, except at Candover where a severe attack of American bollworm occurred in January. All varieties were very badly attacked, being practically stripped of the bolls and buds, but a good recovery was made, especially by the U.4 selections, which as a block yielded no less than 1,200 lbs. of seed cotton per acre. Red bollworm was nowhere strongly in evidence, and what damage was done was easily countered by the reproductive vigour of the plants. Light traps and ratoon trap crops are still under trial.

### Rotation Crops.

Work on rotation crops was continued and considerable progress was made in this direction.

*Tepary beans,* originally imported from Nyasaland, did remarkably well at all the Stations except at Bremersdorp, which, however, is scarcely representative of low veld conditions. This is normally a three months' crop, easy to grow, and threshes readily in a small hand or power thresher.

*Soya beans.*—The chief trouble with this bean, which grows well in the low veld, has been its liability to shed its grain. A yellow variety has been grown which is remarkably free from this tendency. The soya bean is a world's crop with a ready export market. It is easily grown and very easily harvested.

*Sunflower* has been found to do well in the low veld. The crop requires little attention, is drought resisting, and in good soil gives high yields. The chief difficulty has been in the threshing. This has been overcome by using a small power thresher with a bar drum.

With three promising rotation crops in sight the outlook is vastly improved. The next step is to subject them to a thorough test as regards spacing, time of planting, etc., such as has been done with the cotton crop. With the posting of Mr. Parsons to Barberton this has been made possible, and a good start has been made in the present season (1929-30).

# REPORT ON THE WORK OF THE COTTON-BREEDING STATION, BARBERTON. SEASON 1928-29

BY

F. R. PARNELL

WITH THE ASSISTANCE OF

O. V. S. HEATH AND L. H. A. STONE.

## INTRODUCTION.

The authorship of this report is given in the above form as there has been no clear-cut separation of the responsibilities of the officers concerned. The keeping of records of growth, flowering, etc., and the working up of figures for the chief experiments have been the main charge of Mr. Heath. He also wrote the section on "Plant Development and Climatic Conditions." Mr. Stone has been engaged principally with the breeding work, keeping records of selections and working up the laboratory material from them.

Agricultural operations on the Station are in charge of Mr. J. B. McConnell, whose appointment as Farm Manager in December was a great help in the smooth working of the place.

This year the so-called off-season, when the crop is off the ground but inside work is heavy, has been cut very short indeed. Picking was not finished till well into August and the new season started in September. This report, therefore, has been prepared hurriedly and it has been impossible to deal with some of the records that have been made.

## SUMMARY OF PRINCIPAL RESULTS.

In spite of a very late and poor start, the season finished up well and a useful amount of work was carried out successfully.

*Selections.*—The only selections that did really well were those from U.4 and its sub-strains. A number of these gave excellent results,

yielding from 1,400 to 1,750 lbs. per acre of seed-cotton, with lint of good length and quality. About twenty newer selections will be multiplied on areas of one to two acres each: three older lots will cover about eighty acres between them.

*Variety Trials.*—In all the trials U.4 was considerably better than A.12; Z.1 was definitely poorer. Five experiments, with a total of forty-six plots of each variety, gave a mean yield of 1,057 lbs. per acre for U.4 and 711 lbs. for A.12. The local variety, Improved Bancroft, was included in only one trial, where it gave 303 lbs. per acre as compared with 1,012 from U.4.

*Seed Distribution.*—The whole of the U.4 seed available was planted by farmers in the district, giving an area of about 1,000 acres. Thoroughly satisfactory results were obtained over a wide range of conditions. The average yield over the whole area, including many poor stands and late-planted crops, worked out at about 650 lbs. per acre. Yields of from 1,500 to 2,000 lbs. per acre were obtained from a few small early planted fields. The best large-area yield was 1,012 lbs. per acre from 63 acres. A total of 220 tons of seed was produced in the Barberton area and about 190 tons have been distributed for planting in the coming season.

*Planting Dates.*—In a time-of-planting experiment the three varieties included all gave the heaviest yields from the earliest planting and fell off regularly for later dates. U.4 gave acre yields of 1,266 lbs., 936 lbs., 548 lbs., and 323 lbs. for dates ranging from October 26th to December 24th.

*Rotation Crops.*—These were planted rather too late in most cases. Tepary beans did very well, giving 1,819 lbs. per acre from mid-January planting. Soy-beans and cowpeas also did quite well. Groundnuts were better than previously, the three best varieties averaging over 1,000 lbs. per acre. Sunflowers and Kaffir Corn were only fair, probably owing to late planting.

## Season.

The season started very badly indeed but improved about half way through and finished up well. The total rainfall for the year, July to June inclusive, was 19·44 inches as compared with an average of 29·42 inches for the previous thirteen years. It was the second driest year for that period and, in addition, the spring rains were exceptionally late.

Practically no rain had fallen since early in April and the first useful rain of the season was not received till towards the end of October,

*vide* rainfall table and chart (pp. 60 and 61). Owing to the previous very dry condition of the soil this early rain dried out very quickly. It helped the harrowing of land already ploughed, but was not enough to enable new ploughing to be started. Fortunately the greater part of the Station had been ploughed in the autumn, but the farmers who had not been able to do this found the position very difficult.

It was not until after the good rains at the end of November that preparation could be completed and the general planting started. All important material was put in during the last day or two in November and the first week in December, about a month later than is considered to be the best planting time for the area. Good germination and stands were obtained but the early growth was not satisfactory. The November rains had gone in well but, with the hot dry spells that followed and no heavy rain to do more than wet the surface, the soil was never really soaked through and growth was poor in consequence. A certain amount of aphis appeared, still further retarding the crop and doing a good deal of damage in places. Some improvement in the general condition of the plants followed the rain in the middle of January but, in spite of this, the crop was so backward early in February that only very poor results weree xpected. After the good rains in the middle of February, however, really strong growth started, and from that time onwards development was very rapid. Fortunately warm weather continued much later than usual and a large part of the crop was made late in the season.

The final results were very mixed as the different strains reacted differently towards the season. Practically all the U.4 lots were good, many of them giving excellent yields, far better than had been obtained previously on the Station. The other strains were mostly poor to moderate, some being very poor and practically none being really good.

As far as bollworm was concerned the season was a good one. The infestation was very light indeed, except during the latter half of March when American bollworm did some damage. The Sudan bollworm could hardly be found till late in the season and even then only in small numbers.

Jassid was present throughout the Station at the usual time, but did little or no damage to the selected strains. Such few plots as there were of non-resistant varieties were badly damaged in all cases, however, indicating that the general immunity on the Station was due to the resistance of the strains now in cultivation.

### Effect of Fallowing.

A matter of considerable interest that assumed some importance during the season was the effect of a previous fallow on the growth of the subsequent crop. Mention is made of this point here as some reference to the effect will be necessary in dealing with various results later.

The land intended for progeny rows and experimental work generally had been fallowed in the previous season in order to make sure of having it in suitable condition for planting if the spring rains happened to be short. For bulk planting most of the land had been cropped, but there were a few areas, occasionally parts of one field, that had been fallowed.

In all cases, without exception, the earlier growth of the cotton was noticeably better where the land had been cropped in the previous season than where it had been fallowed. This effect of the fallow in depressing the early growth of the subsequent crop was quite unmistakeable and showed up between parts of uniformly planted fields as well as between different fields. The effect was the same whether the previous crop had been cotton, maize or beans, and it was seen on young crops of tepary beans and sunflowers in addition to cotton.

The differences in growth carried on for several months and the cotton following a fallow was definitely later in coming into fruit. Later in the season, however, the differences were reversed and the fallowed land finished its crop better, giving a rather bigger growth and heavier final yield. The latter result appeared, from the look of the plants, to be due to the fallowed land carrying a better reserve of moisture at the end of the season. Had the winter not been late and mild, this final effect of the fallow would not have materialized and the early depressing effect would have reduced the crop.

The depressing effect has been reported from several different places, with varying soils and climatic conditions, and has appeared in several seasons. Differences in treatment of the fallow before putting in the following crops, *e.g.*, time of ploughing, method and amount of other cultivation etc., do not affect the result. It would be premature to hazard any suggestion as to the nature of the effect until further information has been obtained by definite work on the subject. An attempt will be made to start such work in the coming season, but, meanwhile, fallowing as a regular treatment of experimental areas has been given up.

### Selections.

The selections carried forward from the previous season comprised a miscellaneous collection, partly single-plants and partly small bulks,

from all the old strains of importance, together with a number of new single-plant selections from U.4 Bulk. In addition a collection of Cambodia selections, single-plants and bulks, were received from the Magut Station.

The whole of these were planted in the week following the good rains at the end of November. Germination was good and the general stands obtained were excellent. As already stated, however, the main early growth of all the cotton on the Station was distinctly poor and this was particularly the case with the selections since they were planted almost entirely on fallowed land.

It may be stated at once that the U.4 selections, both new and old, gave very decidedly better results than anything else and finished up with a good crop. The other types did not get away so quickly when growing conditions improved, were much slower in fruiting, and gave a decidedly poorer crop. It is obvious, from the experience of the past three seasons, that U.4 and its sub-strains are far more capable of making a crop rapidly, whenever the conditions are favourable for a short time, than any other strain that has been grown on the Station. This characteristic is particularly valuable, as it would appear from all the information obtainable that the majority of seasons in this country are good only in parts and that very few indeed give good conditions throughout the growing period. In a similar manner the power of recovering rapidly after a bad attack of bollworm is a most valuable asset.

In connection with bollworm it may be mentioned that the small boll of U.4 appears to give it a definite advantage over larger-bolled strains. There appears to be a smaller loss of potential crop in the shedding of punctured squares and young bolls, also less cotton spoilt by rotting and disease in more fully grown bolls that are punctured but only partly eaten by the bollworm.

Taking everything into consideration, including the results of variety trials to be referred to later, it is so obvious that U.4 strains are definitely superior to the other types that the latter will be discarded almost entirely. A few lots will be retained, mainly as types, and a few more selections from the Cambodias will be carried forward for further examination.

*U.4 Selections.*—About 200 single-plant selections were put in, a few being carried forward from the old original lots, but the majority being new selections from U.4 Bulk made in the previous season. These lots, as a group, gave a very good final crop, 1,190 lbs. of seed cotton per acre from the whole block of 7½ acres. The land had been fallowed

and, as noted above in connection with fallowing, the yield is rather greater than it otherwise would have been.

The lots varied a good deal between themselves in general habit, earliness, etc., and it was possible to eliminate a certain number as being too woody and unproductive or late. Others were discarded as showing too much variation within the family, but the majority showed very fair uniformity in type of plant. It was of considerable interest to compare the behaviour of different types of plant and it was evident that a number of very different types were capable of giving a heavy crop in a reasonable time. There were many good lots with not much to choose between them as regards yield, though a few were outstanding. The ten best lots, covering about half an acre, gave an average yield of over 1,500 lbs. per acre, the two highest giving over 1,700 lbs.

Some differences were shown in resistance to jassid and a few lots were discarded as not being good enough in this respect. The remainder suffered little or no damage, though the effect of jassid could be seen throughout the block, more particularly on the earliest types.

A leaf-spot caused by *Alternaria* led to a certain amount of shedding of leaves towards the end of the season. A few selections seemed to be more liable to this disease than the others, but it was chiefly noticeable on early lots as they ripened or on patches of crop where the growth was poor. Special selections were made with a view to following up any differences in susceptibility, though it is doubtful whether this disease is likely to be a factor of any general importance.

As regards lint characters, ginning percentage etc., there was a certain amount of variation between lots, but inside the families the uniformity was better than might have been expected and very few lots were discarded for irregularity. The general standard of the selections was distinctly high and many of the best fruiting types produced lint of good length and quality combined with a high ginning percentage.

Lint-lengths were slightly higher, on the whole, than those of the parents in the previous season. Seed weights in most cases were definitely higher, owing to this season's seed being better filled, and this usually resulted in slightly lower ginning percentages. Some idea of the strains may be gained from the statement that follows (Table I) in which figures are given for some of the measurable characters of a number of good lots. Figures for one of the bulks are also included in the same table.

TABLE I.

U.4 SELECTIONS.

SOME GOOD FAMILIES.

| Lot. No. | Yield per Plant,* Special Bulks. (Grms.) | Number of Selected Plants. | Averages for Selected Plants. | | | |
|---|---|---|---|---|---|---|
| | | | Ginning Per-centage. | Boll Weight. (Grms.) | Weight of 100 Seeds. (Grms.) | Lint Length. (Mms.) |
| H.11 ... ... ... ... | 164 | 6 | 36·0 | 5·1 | 10·0 | 31·2 |
| H.67 ... ... ... ... | 167 | 8 | 34·2 | 5·2 | 11·6 | 31·9 |
| H.77 ... ... ... ... | 167 | 9 | 34·2 | 5·7 | 11·2 | 33·1 |
| L.17 ... ... ... ... | 155 | 8 | 34·4 | 5·6 | 10·9 | 32·0 |
| L.18 ... ... ... ... | 153 | 8 | 33·5 | 5·3 | 10·3 | 32·7 |
| C.15 ... ... ... ... | 146 | 8 | 35·6 | 5·4 | 10·0 | 31·6 |
| C.39 ... ... ... ... | 159 | 10 | 34·6 | 4·6 | 9·4 | 31·1 |
| A.22 ... ... ... ... | 150 | 5 | 36·1 | 4·8 | 9·2 | 30·4 |
| Z.9 ... ... ... ... | 167 | 7 | 36·0 | 5·0 | 9·8 | 29·4 |
| Z.12 ... ... ... ... | 153 | 6 | 35·3 | 4·7 | 9·3 | 30·5 |
| Z.14 ... ... ... ... | 144 | 7 | 35·8 | 4·5 | 9·4 | 32·1 |
| U.4/4/2 (Small Bulk) ... | 164 | 40 | 37·1 | 4·9 | 10·0 | 31·2 |

* The spacing was 3′ 6″×2′.

The " special bulks," from which the yield per plant given in the table was caluclated, were made by taking forty to sixty good typical plants, about one-fifth of the total number, from each family. The yield per plant of these bulks forms a useful figure to represent the family. The actual total yield of the eleven progeny rows of the table (as they stood) was 1,430 lbs. per acre.

Single-plant selections have been made from over fifty families, giving a total of about three hundred plants. In addition special bulks, as described above, have been taken from the twenty most promising lots and these will be multiplied provisionally on areas of about one to two acres. A number will also be put into a variety trial with the best of the older U.4 selections that are now on a larger scale.

*Older U.4 Selections.*—The older selections from U.4, carried forward in bulk from the previous season were rather an unknown quantity as the damage done by hail had made it impossible to judge or compare them. There were five larger original lots and a number of smaller ones re-selected from them.

From the smaller lots single-plant selections were taken in a few cases and from two lots special bulks in addition. One of the latter, U.4-4-2, deserves mention. It was a very uniform small type and the earliest of all the strains. In spite of this it gave a yield of 1,059 lbs. per acre from rather a poor stand on fallowed land. Its measureable characters are given in Table I for comparison with the newer selections. It will be seen that the yield per plant of the special bulk compares well with the others grown on fallowed land, and that the ginning percentage and lint length are good. In every way it is a very promising strain.

The five larger lots, U.4-2 to 6, were planted for multiplication on areas of an acre or more each and were also included in a small variety trial against U.4 Bulk. This experiment started well, but the later growth was not as even as could have been desired, aphis during the period of poor growth having led to some patchiness. The results, however, gave some useful information as will be seen from the figures in the following statement, Table II.

TABLE II.

U.4 RE-SELECTIONS VARIETY TRIAL.

Half-Strip Method with U.4 Bulk Standard,

Twelve Comparisons of One Row by Eighty Feet.

| *Strain.* | *Mean Yield per Acre, Seed Cotton, Lbs.* | | *Mean Difference from Bulk.* | *Difference ÷ Standard Error.* | *Remarks.* |
|---|---|---|---|---|---|
| | *Strain.* | *U.4 Bulk Standard.* | | | |
| U.4-2 ... | 1,074 | 994 | + 80 | 1·6 | Increase of low significance |
| U.4-3 ... | 936 | 1,067 | −131 | 3·4 | Significant decrease |
| U.4-4 ... | 1,197 | 1,116 | + 81 | 2·5 | Significant increase |
| U.4-5 ... | 1,006 | 1,130 | −124 | 5·3 | Significant decrease |
| U.4-6 ... | 1,103 | 1,119 | − 16 | 0·5 | No significance |

The trial was conducted on the half-strip method, using Bulk as standard, with six repetitions of two-row plots, thus giving twelve comparisons of one-row half-strips. The results accord very well with those obtained at Magut under quite different conditions, also with the general opinion formed of the strains on multiplication and observation plots. Taking into consideration all the information available, there is little doubt that Nos. 2 and 4 are the best, and that No. 4 is quite definitely an improvement on the Bulk. It has been decided, therefore, to discard the others and to carry on with 2 and 4 in the coming season.

Special bulk seed only will be used as neither of the strains could be rogued or selected in the previous season. In the case of U.4-2 a batch of single-plant selections has also been taken.

The following amounts of seed are available for multiplication :— U.4-2 about 110 lbs., U.4-4 about 270 lbs., and U.4-4-2 about 40 lbs. The two first will be grown by several local farmers as well as on the Station, the last on the Station only. These three strains, together with U.4 Bulk, will be compared in a number of variety trials and observation plots scattered over the Low Veld.

It has to be borne in mind in the whole of this work that for a strain to be successful in this country it must be capable of giving good results over a very wide range of conditions. This faculty is one of the notable features of U.4 Bulk, and the selections from it will have to be watched carefully to see that it is not lost. Some of the more vigorous types may do well in poorish conditions, but become too big and woody to give a really good crop in good conditions. Similarly a small type like U.4-4-2 may be excellent in fairly good conditions, but just too small to be good enough in poor conditions. Fortunately the selections cover a fairly wide range in types of plant and it will be most instructive to compare these over several seasons under widely different conditions. Only after this has been done will it be possible to decide which is the most generally useful type.

### VARIETY TRIALS.

The variety trials of the previous season had shown U.4, A.12 and Z.1 to be the three best strains, with definite evidence that U.4 was decidedly the best. The trials put in this season were for the purpose of checking those results before discarding A.12 and Z.1. Three simple variety trials were conducted and a fourth combined a variety trial with a time-of-planting experiment.

Two variety trials on the half-strip method, containing the above three strains only, were planted on different types of soil. One was on the Station where the soil is a deep red loam. Here there were nine repetitions of eight-row plots, eighty feet in length, giving eighteen comparisons of four-row half strips. The other was planted on a light granite soil on the farm of Mr. E. T. E. Andrews, who very kindly provided a plot for the purpose. In this case there were six repetitions of six-row plots, giving twelve comparisons of three-row half-strips. In each case A.12 was used as standard.

Very similar and most definite results were obtained from the two experiments, U.4 being outstandingly the best and Z.1 being definitely the poorest in both cases. The figures are given in Table III, from

which it will be seen that the differences between the varieties are very marked. Even the smallest difference, that between A.12 and Z.1 on the granite, is 4·5 times its standard error, and is, therefore, of a very high degree of significance. It may be noted that, out of the thirty comparisons of the two experiments, U.4 exceeded A.12 in every case; similarly A.12 exceeded Z.1 in twenty-eight cases.

TABLE III.

HALF-STRIP VARIETY TRIALS.

| *Soil.* | *Half Strip.* | *No. of Comparisons.* | *Mean Yield per Acre, Seed Cotton, Lbs.* | | | *Difference from A.12* | *Difference ÷ Standard Error.* |
|---|---|---|---|---|---|---|---|
| | | | *U.4.* | *A.12 Standard.* | *Z.1.* | | |
| Cotton Breeding Station, Red Loam | 4 rows 80′ | 18 | 1,075 | 625 | — | +450 | 19·4 |
| | | | — | 584 | 370 | −214 | 12·1 |
| Andrews' Granite | 3 rows 90′ | 12 | 1,027 | 772 | — | +255 | 12·6 |
| | | | — | 777 | 692 | − 85 | 4·5 |

In the third experiment the local variety, Improved Bancroft, was included with the same three strains. In this case the varieties were randomized in blocks, according to the method recommended by Fisher. The plots were four rows by sixty feet, repeated eight times for each variety. This experiment was conducted on the Station and the results for the three strains were very close indeed to those of the other trial on the Station described above. The mean yields of the varieties, together with the standard error of the variety means calculated by Fisher's analysis of variance method, are given below.

RANDOMIZED BLOCKS VARIETY TRIAL.

| | *U.4.* | *A.12.* | *Z.1.* | *Improved Bancroft.* |
|---|---|---|---|---|
| Mean Yields, Lbs. per Acre, Seed Cotton ... ... ... ... | 1,012 | 695 | 409 | 303 |
| Standard Error of Variety Means ... | 29·0 | | | |

The lowest difference, that between Z.1 and Improved Bancroft, is highly significant, the larger differences are still more so.

All the plots of Improved Bancroft were badly damaged by jassid and their yield is quite as much as could be expected of them. The Z.1, on the other hand, made a big healthy plant which gave a most disappointing yield—though still one third more than the local Ban-

croft. Z.1 was disappointing in all the trials on the Station; on the granite it yielded about what was expected. The reason for its poor yields on the Station is not altogether clear, but will be referred to again when discussing the time-of-planting experiment. Whatever the reason, the fact remains, and it is a satisfaction to be able to replace all the Z.1 in cultivation by U.4 for the coming season.

The trial in which the three strains were combined in a time-of-planting experiment is described elsewhere. The figures for yield of the first two plantings are given in the statement below (Table IV) which combines the yield figures for the three strains during the season at Barberton. In the case of the half-strip trials the figures for U.4 and Z.1 have been adjusted to correspond with one figure for A.12, the mean for the whole experiment.

TABLE IV.

VARIETY TRIAL RESULTS CONSOLIDATED.

| *Experiment.* | *Time of Planting.* | *Yield of Seed-cotton, Lbs. per Acre.* | | |
|---|---|---|---|---|
| | | *U.4.* | *A.12.* | *Z.1.* |
| Half-strip, Cotton Station ... | November 29 | 1,040 | 605 | 384 |
| Half-strip, Granite ... ... | December 3 | 1,030 | 775 | 689 |
| Randomized Blocks ... ... | November 30 | 1,012 | 695 | 409 |
| Time of Planting 1 ... ... | October 26 | 1,266 | 874 | 490 |
| Time of Planting 2 ... ... | November 26 | 936 | 607 | 297 |
| Mean ... ... ... ... | — | 1,057 | 711 | 453 |

The consistency of the results and the magnitude of the differences between U.4 and A.12, the next best, furnish thoroughly reliable evidence of the superiority of U.4, thus confirming the previous season's results in a most conclusive manner.

The behaviour of U.4 over four seasons, in the first of which it was in the original progeny row, has been extremely satisfactory throughout. In no single instance, whether in good or bad conditions, on the Station or in the district, has it failed to show up well. Further work, therefore, will be concentrated almost entirely on U.4 and its sub-strains.

*Edge Effect.*—In the half-strip trial on the Station the plots were made eight rows in width with a view to cutting off outside rows if necessary. For all plots each single row was picked and weighed separately, so that it was possible to determine whether one strain affected the adjacent row of its neighbouring strain.

A comparison of the second row with the outside row adjacent to A.12 was made for all plots of U.4 and Z.1. In each case the difference was entirely negligible, the mean difference for eighteen comparisons being 0·02% of the row yield for U.4 and 0·1% for Z.1. It was obvious that the proximity of A.12 had not made the slightest difference to either of the others.

The reverse effect, that of U.4 and Z.1 on A.12, was also tested in the same manner. Here the differences were more appreciable, the rows bordering U.4 giving 4·9% less and those bordering Z.1 giving 5·3% more than the corresponding second rows. The standard errors of these differences were 3·5% and 3·9% respectively, giving a probability of about 0·2 in each case. The recorded differences are certainly not significant and the fact that they are in opposite directions, in spite of the fact that both U.4 and Z.1 gave a definitely stronger growth than A.12, also suggests that they were accidental.

Similar comparisons will be made again in the coming season, but the variety trials will be designed on the assumption that border effect between varieties may be neglected.

*Trampling Effect.*—Another matter that appeared to be worth considering was the possible effect of constant trampling on plots in which daily flower-counts were being made. Any handling of the plants during flower counting was, of course, included with the trampling.

Flower counts were made on six plots of each of the three varieties. In each plot the two middle rows only out of the eight were used for counting, and the trampling was confined to the space between these two rows. The yields from the two trampled rows were compared with those of the adjacent untrampled rows on either side. It was found that the differences were small and irregular, the trampled rows giving a mean decrease of 2·2% and 3·7% for U.4 and A.12 respectively, and an increase of 5·4% for Z.1. The two former differences were less than their standard errors; the 5·4% increase for Z.1 had a standard error of 4·7%.

It is obvious that the differences mean nothing, but it should be noted that the rows tested were trampled on one side only and that the season was comparatively dry. A greater amount of trampling in a wetter season might have some effect. It will be assumed, however, that trampling does no harm, and flower-counting in variety trials will be continued in the coming season. The point will be tested again, it is hoped in a wetter season, as a check on the above results.

*Width of Plot.*—An analysis of the figures from variety trials is being made with a view to determining the relative errors that may be

expected from plots of varying widths. There has not been time to complete this examination and the subject cannot be dealt with fully till a later date.

The standard error has been worked out for the difference between adjacent plots of one row and two rows respectively. Eighteen four-row plots of U.4, eighty feet in length, were used for the purpose and the differences taken were : (1) between the second and third row for one-row plots, (2) between the first two and the second two for two-row plots. Thus in both cases the comparisons were made across the same dividing line in the plot. The standard error of the mean difference, 18 comparisons, came to 2·5% of the yield for the one-row plots and 2·3% for the two-row plots, a rather surprisingly close agreement. These results will be checked by figures from a much larger series of plots. In addition, similar figures will be obtained for three and four-row plots.

### SEED MULTIPLICATION AND DISTRIBUTION.

As mentioned in last year's report practically all the cotton growers of the area decided to put in nothing but jassid-resisting strains. A limited amount of U.4 seed was supplied to each farmer for planting at 5 lbs. per acre, and a larger quantity of either A.12 or Z.1 to make up the full amount required.

Reference has already been made to the difficulties of the early part of the season. The general backwardness of the preparation led to a considerable curtailment of the area that should have been planted. In addition, the greater part of the crop was late and much of it was planted in very poor conditions. U.4 generally received more attention than the other varieties, and, for this reason, it would be unfair to compare it directly with them as regards the general yields obtained. There could be no doubt, however, that U.4 gave decidedly the best results and that Z.1 was generally poor, thus bearing out in practice the results of the variety trials already described. It was decided to distribute U.4 only in the coming season and to discard A.12 and Z.1 for practical purposes in the area.

The amount of U.4 seed distributed to members of the Barberton Cotton Co-operative Company was 8,885 lbs., sufficient for 1,777 acres if conditions had been good. Unfortunately the final area that was carried through is not known accurately, but the returns of members who sent in seed-cotton showed a total of 950 acres planted. The actual area picked would be appreciably less than this as there would certainly be occasional portions of poor stand abandoned and ploughed out. The whole crop was thinly planted and much of it was very late.

In spite of all this the seed-cotton sent in amounted to a return of 650 lbs. per acre from 950 acres.

In view of the circumstances this total yield is very good indeed and has confirmed the optimism prevailing at the end of the previous season. The results have been most satisfactory from both ends of the scale—in very poor conditions the yields have been more than could have been expected; in good conditions some excellent yields have been obtained. Occasional small areas planted early, that is to say at about the normal planting time, have given yields of from 1,500 to 2,000 lbs. per acre.

The best returns for this area were obtained by Col. G. M. Bennett, a local farmer who had a rainfall of 27 inches for the season, decidedly better than the district generally, but no more than the average. His figures, given below, are of interest in showing big variations in yield due to simple causes, though all the yields are good for the conditions.

| *Time of Planting.* | *Acres.* | *Yield, per Acre Seed-Cotton Lbs.* | *Land.* |
|---|---|---|---|
| Oct. 27–29 ... | 9½ | 1,864 | Old tobacco land. 200 lbs. Super. |
| Oct. 30 ... ... | 5¾ | 1,340 | Ordinary land. 200 lbs. Super. |
| Nov. 1–30... ... | 26¼ | 880 | Do. do. |
| Dec. 5–7 ... ... | 21½ | 706 | Do. do. |
| Total ... ... | 63 | 1,012 | |

Part of the above 9½ acres on old tobacco land, a small field of two acres, gave 2,200 lbs. per acre. It should be noted that very little damage was done by bollworm at any time in the season.

Taking about the first two-thirds of the whole crop of the area, over two hundred tons, the amount of lint baled against the seed-cotton weighed in at the ginnery gives a ginning percentage of 32·35. This is a very good figure for a commercial crop in the ginnery, though a little lower than last season owing to the seed being better filled. The main bulk of the early crop was graded full 1⅛″ in staple, with occasional lots of 13-16″.

The total amount of seed produced in the Barberton area was 220 tons. Of this about 190 tons have already been distributed for planting purposes, about two-thirds of it being sent to other areas. Arrangements had been made earlier in the season for rationing the seed, but the amount produced was so much above expectation that this was not necessary and it was possible to supply growers throughout the Low Veld with as much as they required.

The Barberton Co-operative Company and their Ginnery Staff have again rendered very valuable assistance in the multiplication and distribution of the seed.

### TIME OF PLANTING.

An experiment was conducted with a view to following the development of the plant in its relation to the time of planting. Since it was possible that different types of plant would behave differently, the three strains, U.4, A.12 and Z.1, representing three quite distinct types, were all included in the experiment. The first planting was put in at the earliest opportunity, near the end of October, and it was intended to follow this at fortnightly intervals if possible. The second lot failed to germinate, however, and had to be re-planted. The result was an interval of a month between first and second plantings and of a fortnight between the others.

The three varieties were planted in adjacent plots, forming one block, and four such blocks scattered over the area were put in for each planting. Edge effect was avoided by discarding two rows where plots adjoined a different planting and one row where different varieties of the same planting came together. The plots were sixty feet in length, with two-foot spacing in the row and three-and-a-half feet between rows.

*Yield.*—The relation between time of planting and final yield was very striking. As will be seen from the figures given below (Table V) all three varieties gave markedly the biggest crop from the earliest planting, with a large reduction for each subsequent planting.

TABLE V.

TIME OF PLANTING EXPERIMENT.

| *Planting Date.* | *Yields of Seed Cotton Lbs. per Acre.* | | | *Yields as Percentages of First Planting.* | | |
|---|---|---|---|---|---|---|
| | *U.4.* | *A.12.* | *Z.1.* | *U.4.* | *A.12.* | *Z.1.* |
| 1. October 26 ... ... | 1,266 | 874 | 490 | 100 | 100 | 100 |
| 2. November 26 ... ... | 936 | 607 | 297 | 74 | 69 | 61 |
| 3. December 11 ... ... | 548 | 289 | 171 | 43 | 33 | 35 |
| 4. December 24 ... ... | 323 | 170 | 90 | 26 | 19 | 18 |

It is generally considered that the best time of planting for the area is from the middle of October to the middle of November, and it is unfortunate that the dates of the experiment did not cover this range better. The importance of early planting, however, is very obvious, though it does not follow that there would be such large differences in all seasons. If early growth conditions had been better it is likely that the later plantings would not have fallen off so badly. On the other hand, an earlier and more severe winter would have accentuated differences.

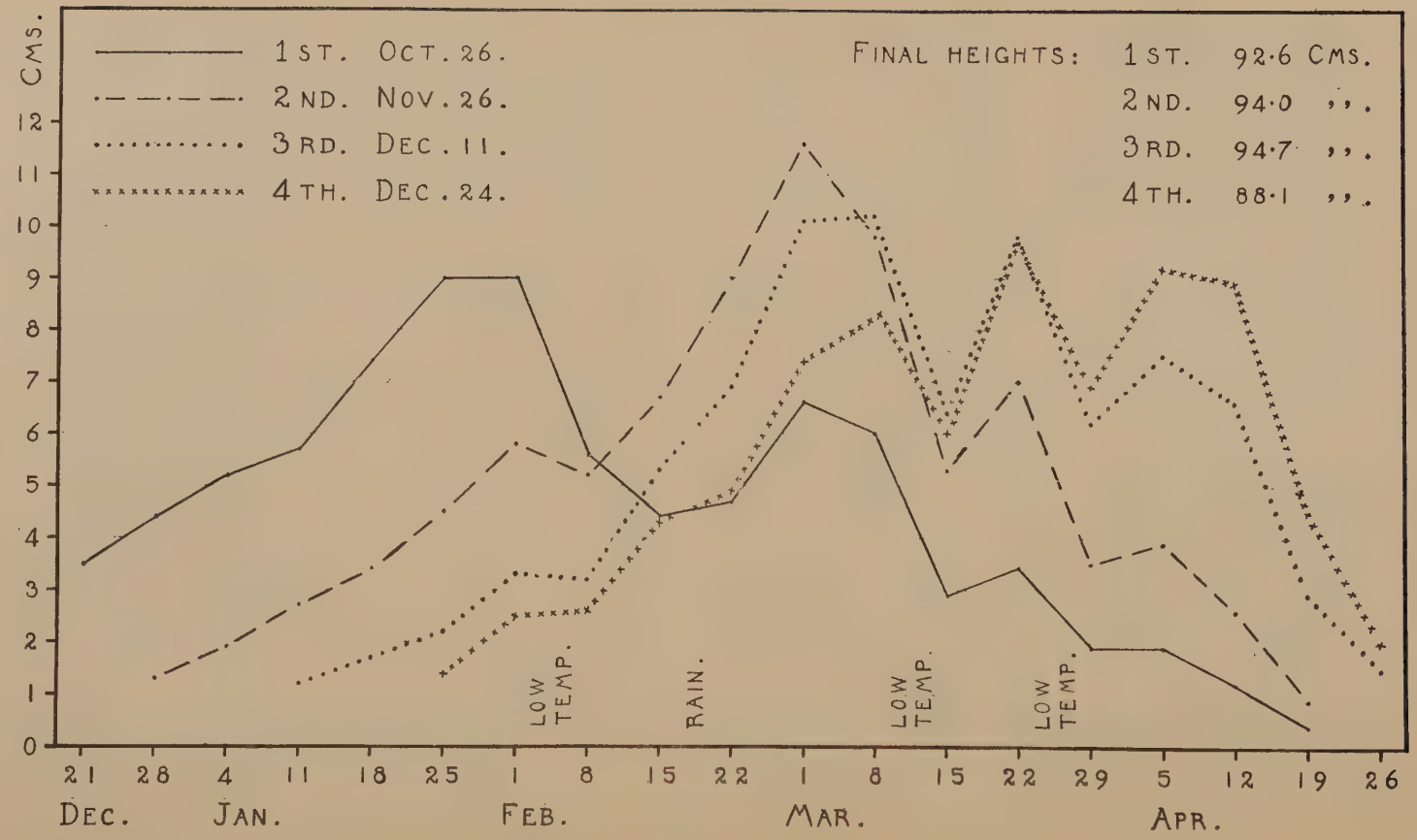



FIG. 1. TIME OF PLANTING EXPERIMENT. WEEKLY GROWTH INCREMENTS OF U.4.

It may be noted that the whole of the cotton on the Station, with the exception of this experiment, was planted during the period between the second and third dates of the above table. The bulk of the general crop in the district was also planted during this period. It will be seen, therefore, from a glance at the figures, that the references in this report to the adverse effect of the lateness of the season are not without foundation.

The very great superiority of U.4 over A.12 and Z.1 is again most evident for all the plantings. It is of interest to notice, as shown by the percentage figures given, that the yields of the late plantings fall off rather less in the case of U.4 than with the other strains.

*Growth.*—Weekly growth measurements were made on sixty plants of each variety for each planting. Only the figures for U.4 have been worked out so far and there has been no time to consider even these in detail. The simple curves for growth increments of the main stem are given in Fig. 1 for the four plantings. It should be noted that the dates represent the day on which the growth of the previous week was measured.

It will be seen that during the early growth the increments were substantially the same and steadily increased in about the same manner for all four plantings. The temporary check, from 1st to 8th February, of the last three plantings was probably due to a fall of temperature and heavy wind during that week. The very large fall in the first planting, from before 1st up to 15th of February, was almost certainly due to lack of sufficient moisture to support rapid development in a plant of some size. The three later plantings started good growth again before the rain, the smaller plants being less affected by the dry conditions. From the middle of February there was no shortage of moisture and dips in the curves appear to be due to falls in temperature.

It is clear from the curves, and from the final height figures noted against them, that the general growth was not much affected by time of planting, though it fell off more rapidly at the end with later plantings.

*Flowering and Bolling.*—Daily flower counts and weekly counts and pickings of open bolls were made from three rows in each plot, *i.e.*, twelve rows of each variety for each planting. The results are given in some detail as they are of interest in showing varietal differences in addition to the time-of-planting effects.

The three varieties behaved very similarly in their reaction to differences in time of planting and it will be sufficient to give the results

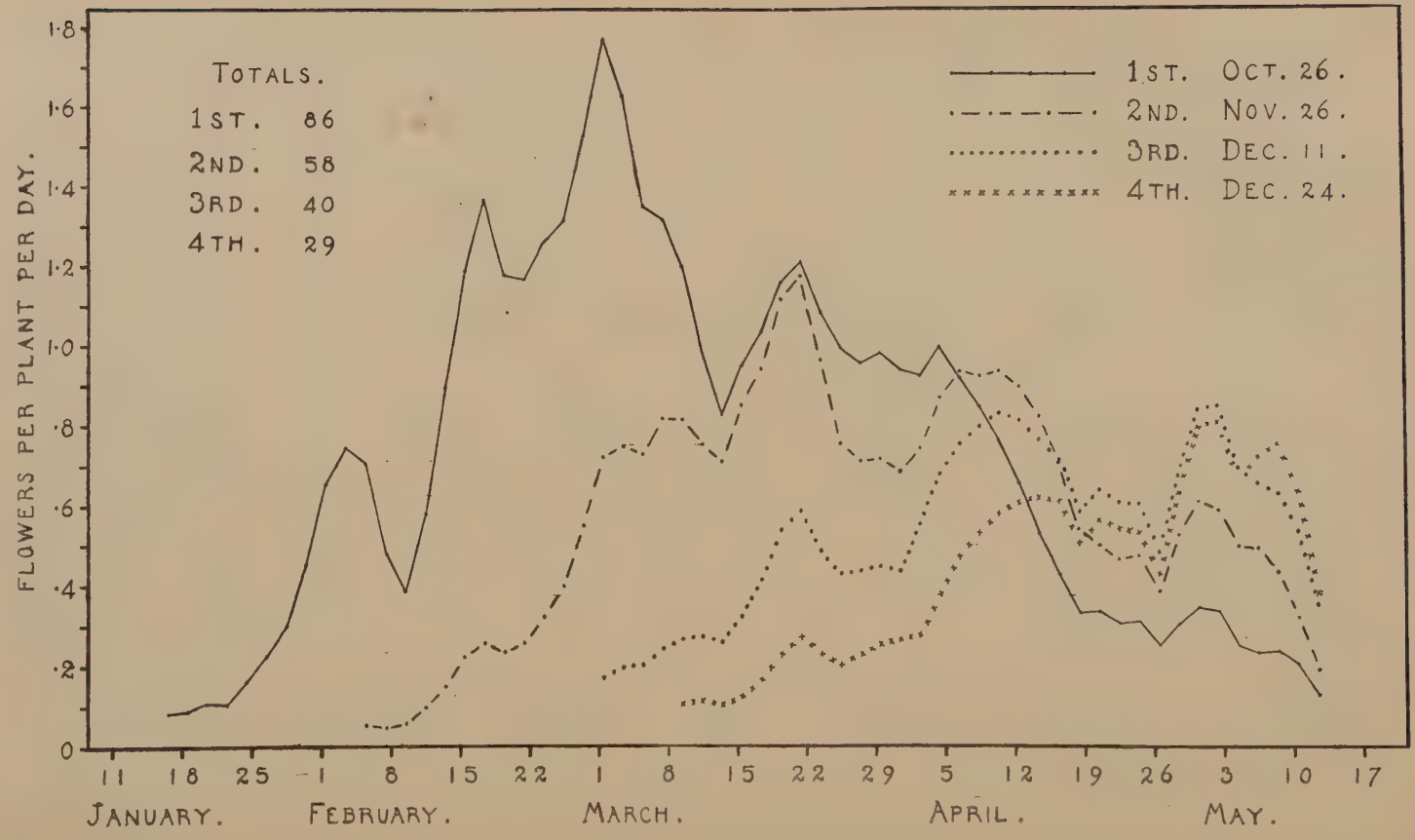



FIG. 2. TIME OF PLANTING EXPERIMENT. DAILY FLOWER COUNTS OF U. 4. (SMOOTHED.)

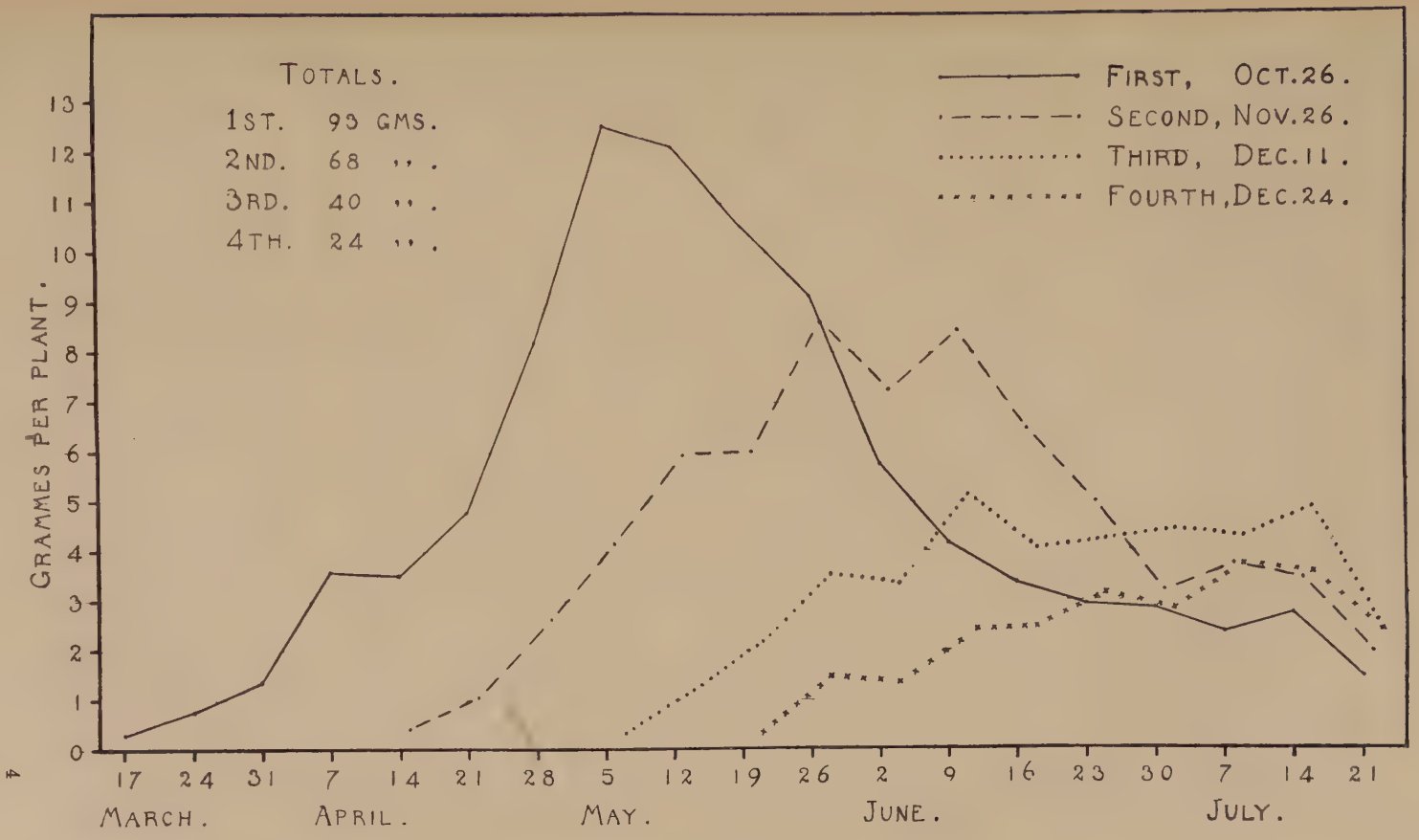



FIG. 3. TIME OF PLANTING EXPERIMENT. WEEKLY PICKINGS OF U. 4.

for U.4 only. Flowering curves for the four plantings of U.4 are given in Fig. 2 (p. 48). The daily figures were originally smoothed to five-day overlapping means but, as further smoothing was desirable and time was short, the figures used were two-day means of the smoothed daily figures. As would be expected, later planting resulted in later flowering, but the point of chief interest lies in the fact that the numbers of flowers produced in their main flushes decreased successively and very markedly with the later plantings. The first planting produced a very big flush before the second was well started, and, in addition, carried on with slightly more than the second when the latter was at its peak. It was much the same for each interval in the plantings. In the first three the later planting continued flowering longer, but the amount gained by this later flowering was negligible as compared with that lost on the earlier flushes. The fourth planting did not get ahead of the third, even at the end, but finished the last month about equal with it.

It is of interest to compare these curves with those for growth (Fig. 1), where later plantings gave later growth which was otherwise very similar for all and finished up at about the same total. It may be noted that the size of the plant at the time of most vigorous flowering was successively greater for later plantings.

A careful study of the main factors concerned, moisture, temperature, sunshine, etc., would be necessary before expressing an opinion as to their relative importance in contributing to the above results. It has to be remembered that the buds are developing for several weeks before the flowers open. The rapidity with which the buds are laid down in the first instance, their rate of development, the losses from shedding, either physiological or through bollworm, etc., are all factors concerned in the rate of production of the resultant flowers. There has been no time to examine the records at length, but there are indications that temperature played an important part. With a repetition of the experiment in the coming season, and a detailed study and comparison of all the records, it is hoped that some definite conclusions will be possible.

Curves showing the weekly pickings of clean cotton, for the four plantings of U.4, are given in Fig. 3 (p. 49). They are very much as would be expected from the flowering curves. There is some indication that the second planting made better use of the flowers it produced during about the first half of April than did the first planting for the same time. This was presumably due to the fact that the first planting was already carrying a heavy crop and was less able to hold more bolls. The fourth planting falls off at the end rather badly as compared with

the third, though it should have been equal since they were flowering about equally during the last month.

A record was kept of the number of bolls produced, including any that were damaged or did not quite mature. It is of interest to compare the total number of bolls formed with flowers produced for the different plantings. Putting this as a percentage figure, the following results were obtained from U.4 :—

| | *First Planting.* | *Second Planting.* | *Third Planting.* | *Fourth Planting.* |
|---|---|---|---|---|
| Fully matured by July 26 ... ... | 35·0% | 31·3% | 28·6% | 23·8% |
| Total, with clean-up on Aug. 20 ... | 36·4% | 34·1% | 39·4% | 35·3% |

The total percentages of actual bolls developed show less variation than might have been expected for the different plantings. The late clean-up, however, contained practically no cotton of any value, the bolls having failed to mature properly, and the first set of percentages represents the position from a practical point of view. It will be seen that the proportion of immature bolls increases with lateness of planting, amounting to no less than one-third of the whole number for the last planting.

General varietal differences in flowering and bolling will be seen from Figs. 4 and 5 (pp. 52, 53), which give curves for the first two plantings of U.4, A.12 and Z.1. As would be expected, the flowering of U.4 was definitely the highest and of Z.1 the lowest. It will be seen that A.12 improved, as compared with U.4, and Z.1 fell off as the season advanced for both plantings. The bolling curves fall into line with those for flowering, except that the differences between the strains are greater. The reason for this is obvious from the figures for percentages of bolls to flowers for the three strains. Taking the total number of bolls formed, including the late clean-up of immature bolls, the following figures were obtained :—

| | *U.4.* | *A.12.* | *Z.1.* |
|---|---|---|---|
| First Planting ... ... ... ... ... | 36·4% | 22·6% | 16·7% |
| Second Planting ... ... ... ... ... | 34·1% | 22·4% | 15·0% |

The strains show very big differences in the power to hold their bolls, and this is a most important factor in their relative cropping powers.

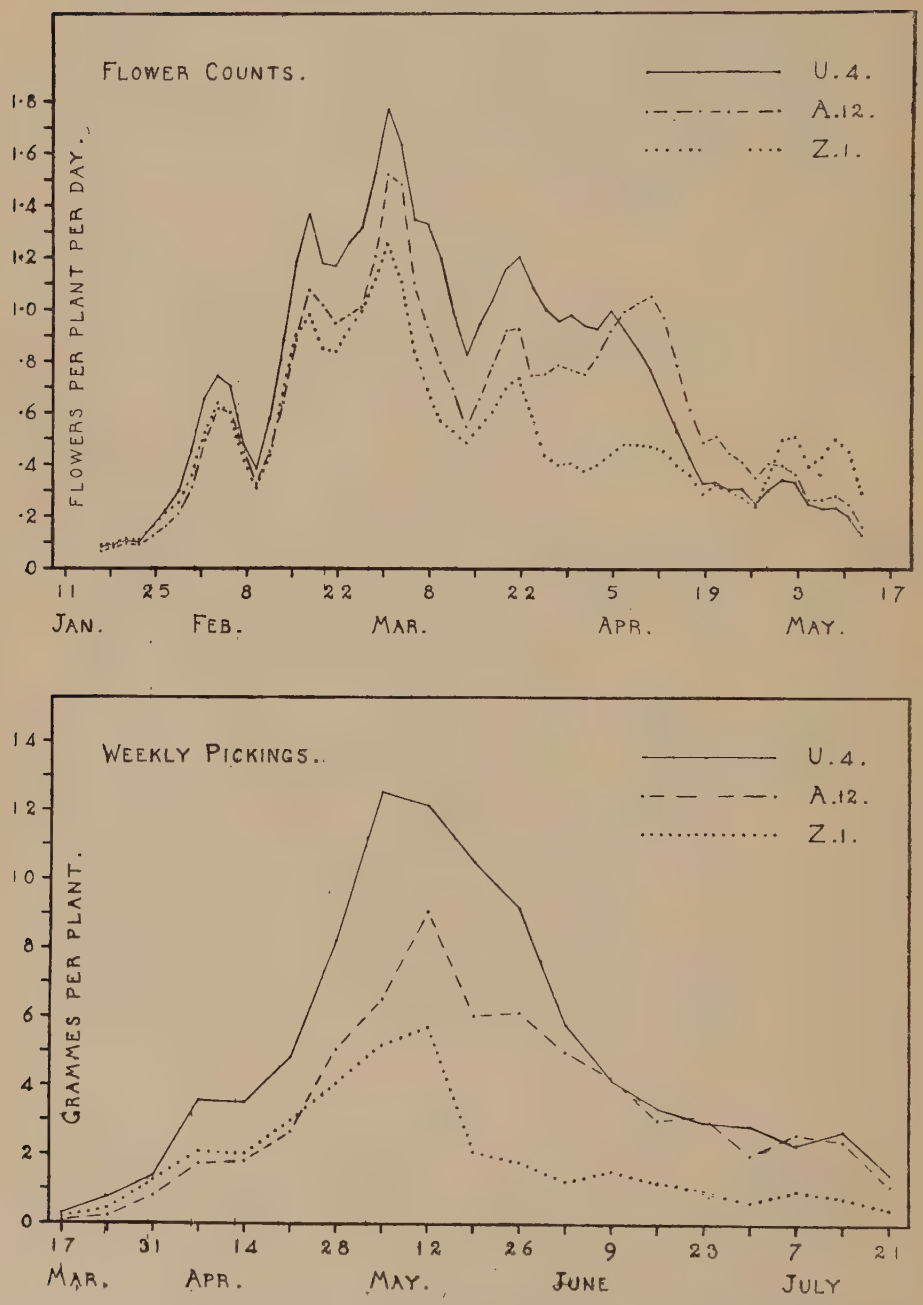



FIG. 4. TIME OF PLANTING EXPERIMENT, FIRST PLANTING, OCT. 26.

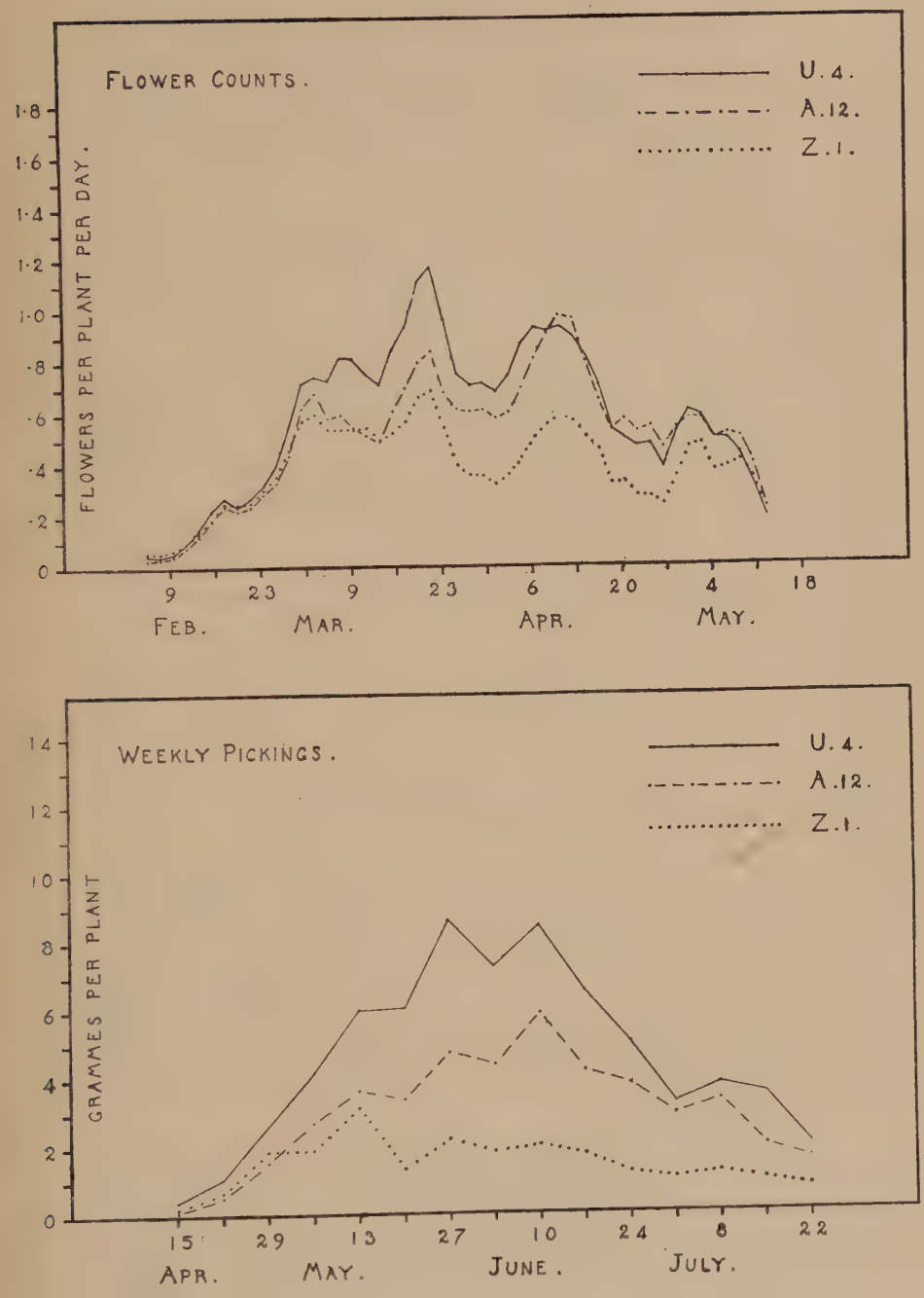



FIG. 5. TIME OF PLANTING EXPERIMENT, SECOND PLANTING, NOV. 26.

### Plant Development and Climatic Conditions.

A series of daily and two-daily observations of growth, flowering, boll-shedding and boll-opening was made in order to examine the effect of climatic conditions, as given by meteorological data, upon plant development.

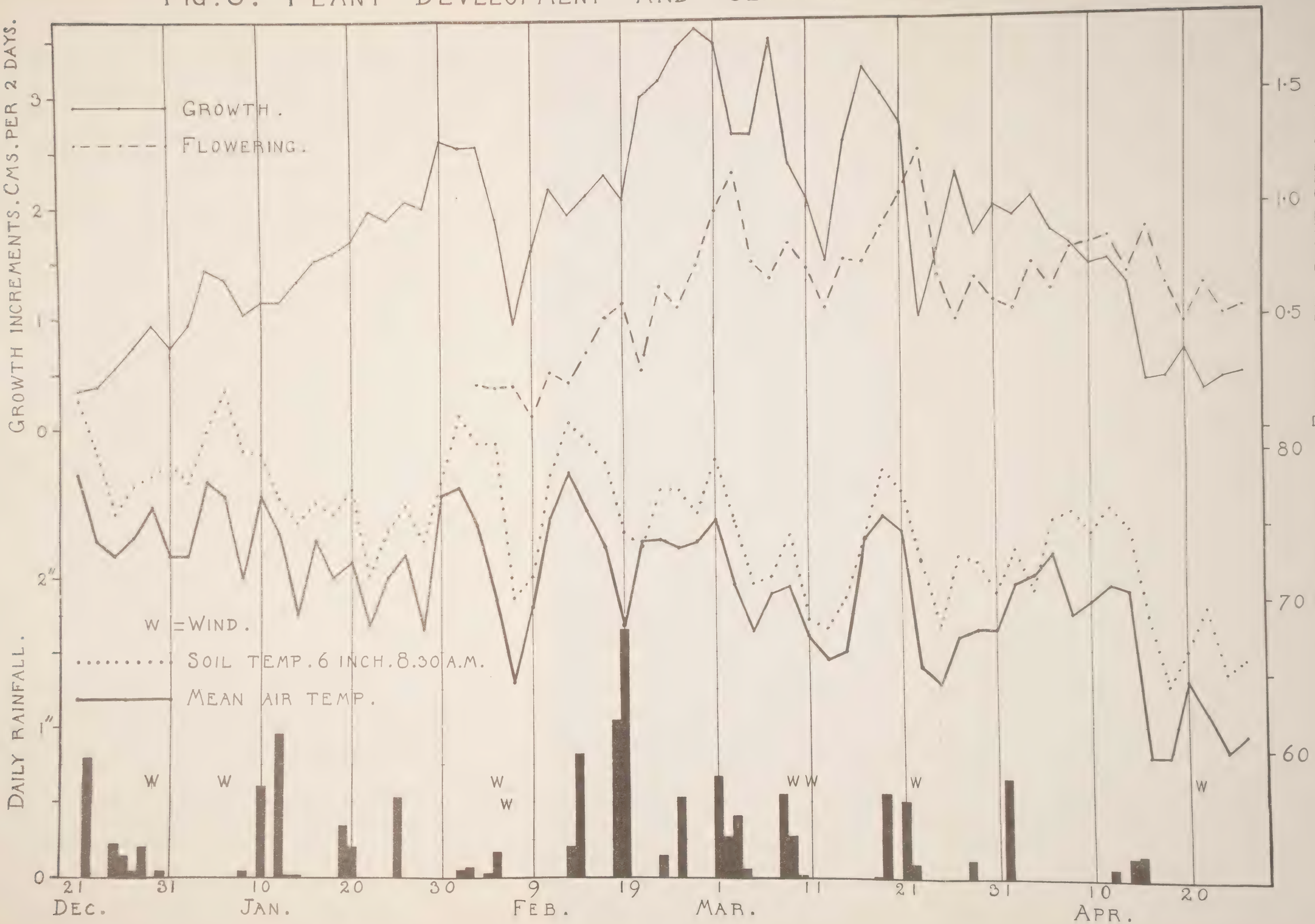
These observations were made on a one-sixth acre plot of Z.1/9, the purest strain available. The plot was planted on November 12th, but owing to poor moisture conditions germination was late and the seedlings did not appear until November 29th. A good stand was obtained at $3\frac{1}{2}$ ft. between rows and 2 ft. in the row.

When the plants were about three weeks old six " average plants " were selected by eye in each of thirteen rows, 78 plants in all. These were measured from ground level (the head of a six-inch nail driven flush) to the base of the apical bud. The extremes were rejected and more nearly average plants taken instead, this giving a very uniform set of plants with a mean height of 10·4 cms. and a standard error of 0·29 cms. These 78 plants were used throughout the season for all the observations, except that any plant becoming damaged was replaced by a substitute. In such cases the new plant taken was as nearly as possible of the same size and habit as the original one. The plants were measured on alternate days throughout the growing season. All flowers were counted and marked with dated tags on the day of opening, and the shedding or opening of the tagged bolls was also noted daily. Unfortunately the shedding and boll-opening data have not yet been worked up owing to lack of time.

The two-daily growth curve and the flowering curve (2-day means) are shown in Fig. 6, together with meteorological data. It should be mentioned that when the plants were taken in three groups of 26, the three growth curves so obtained were practically identical and nearly every small fluctuation showed in all three. This indicates that a much smaller number of plants than 78 would have given reliable data for growth and that considerable confidence may be placed in the curve shown.

The meteorological data examined in connection with these observations were :—Rainfall, evaporation (measured with an open pan at ground level), soil temperatures (6 inches and 12 inches below the surface), maximum and minimum air temperatures, and mean air temperatures. Notes were also kept of high winds when they occurred. A record of sunshine had been kept, but time was not available for getting out the figures.

# FIG. 6. PLANT DEVELOPMENT AND CLIMATIC CONDITIONS.



It will be seen that the growth and flowering curves are very similar, the main movements being common to both. The most important factors affecting them were apparently temperature and rainfall. Rain was often followed by a fall in temperature and then might cause a temporary falling off in growth and flowering. The biggest growth was at the end of February, following heavy rains, when there were showers, fairly high temperatures, and low evaporation.

It is difficult to trace any regular connection between evaporation and growth or flowering, except where the evaporation curve resembles the temperature curves. The evaporation is not shown, therefore.

It is obvious from the curves that a high degree of correlation exists between temperature and growth-rate and flowering. The soil temperature curve is similar to that for air temperature but shows a slight lag at times. The 6-inch and 12-inch soil temperature curves were very similar, except that the latter had fluctuations of smaller amplitude, so only the former is shown. The maximum and mean air temperature curves also resembled each other, but the latter was smoother and gave a better fit with growth and flowering. This "mean air temperature" is not the mean of the maximum and minimum readings, but is obtained from thermograph charts, the mean temperature for each 24 hours being taken as that temperature which gives equal areas of the thermograph curve above and below. The short-period fluctuations in the growth curve agree with those in the temperature curves (especially the air temperature curve), to a considerable extent. The short-period fluctuations in the flowering curve also follow those in the air temperature curve fairly well but with, in most cases, a lag of two days. Apparently, therefore, the factors favourable to growth also favour flower opening, as distinct from the laying down of flower buds, but need about two days to take effect.

Of the factors examined, temperature would appear to be the most important in determining the short period fluctuations in the growth rate and flowering of cotton at Barberton under last season's conditions.

It is hoped to obtain information as to bud production, shedding (due to bollworm and other causes), maturation periods, boll weights, lint characters etc., when more time is available for working up the data collected.

Similar observations will be carried out in the coming season and it is hoped also to obtain some record of soil moisture conditions, an important factor that could not be dealt with previously.

### Rotation Crops.

It was not possible to give any attention to rotation crops till the main bulk of the cotton was planted. A series of plots of Kaffir Corn was hurried in on December 15th, but everything else was a week or more later. The preparation of the land had been difficult, and dry conditions prevailed during the time of the main early growth ; thus the rotation crops were not given an easy time. The work on these crops, up to date, has been of rather a perfunctory nature, though useful information has been obtained. Now that Mr. Parsons has joined the Staff at Barberton, and is taking over this work, much greater attention will be given to it in all its aspects.

*Pulses.*—The dry conditions during the early stages were not good for the pulse crops but they picked up very well later. Growth on the whole was rather less than in the previous season, but the fruiting was almost as good.

Tepary Beans, *Phaseolus acutifolius*, again did very well indeed. The observation plot of about half an acre, planted on December 24th., gave a yield of 1,819 lbs. per acre, an excellent yield for any bean crop. It was planted at two feet between rows and about six inches apart in the row, a much more suitable spacing than the three feet by six inches of the previous season. This plot gave a small early crop that was picked separately in the middle of March, but the main crop, produced after moisture conditions improved, was harvested a month later.

An area of about seven acres that had been intended for a fallow before the effects of fallowing had been seen was planted with Tepary Beans on 15th January. This crop was stuck and made little growth for some time but came away well with late rains and gave a good yield of 1,335 lbs. per acre, harvested at the end of April.

This bean has behaved very well for the past two seasons and is most promising. It is very convenient for rotation with cotton as it can be planted late, after cotton planting is finished, and harvested early, before picking is started in earnest. In addition, it leaves the land in condition for ploughing immediately it is harvested. It is very easy to handle as it does not shatter easily and can be left to ripen in the field. The whole plant is pulled and windrowed before carting to the stack or thresher. A thresher with bar beaters was found to deal with the whole of the plant very effectively. Another useful feature of this bean is that the seed is not attacked by weevils.

Soy beans did very much better than their yield would indicate. The actual yield was only 616 lbs. per acre, from a one-third acre plot, but the stand was very poor and the spacing of three feet between the

rows was obviously too wide. Only one type was planted, a yellow-seeded variety of unknown name. As in the previous season it did not shatter, though left in the field till it was dead ripe. This crop must also be looked upon as distinctly promising, a definite advantage being that it is a well-known bean commanding a good price in an existing overseas market. This bean also is not attacked by weevils.

Cowpeas made fair growth throughout the dry early part of the season and finished up with a good cover. The heaviest growth was made by New Era, but Whippoorwill, Iron and Brabham also did fairly well. Sickler was thoroughly bad, the leaves and pods suffering severely from some disease. The yields of seed are not available, but they were decidedly less than in the previous season. The crop is not easy to handle for seed purposes as the pods have to be picked by hand ; moreover the fruiting is rather uncertain and it is a long duration crop. Its behaviour during the last three seasons on the Station show it to be more particularly useful for fodder or green-manuring purposes.

Ordinary Velvet Beans have shown themselves to be too slow for these conditions and decidedly inferior to cowpeas. The same applies to a bush type from Nyasaland that was grown this season.

Mung again gave very disappointing results as a seed crop. It is particularly liable to damage by the C.M.R. beetle that eats off the flowers. The season was too dry for it to give a heavy growth of green stuff and it was definitely inferior to cowpeas in this respect.

Lima bean was tried for the first time but was not promising. The growth was poor and little seed was produced since the pods nearly all shed after attaining almost full size. The beetle damaged this crop also.

Sunnhemp again did well and made a good steady growth in spite of the dry season. The plot was left for seed and gave about 800 lbs. per acre from just under half an acre. This crop has now given good results for the past three seasons and is obviously suited to the area. It may prove to be a better green-manure crop than cowpeas, though it is not of the same value for other purposes.

*Cereals.*—Maize was grown on a number of fields but nowhere experimentally. The earlier plantings, on land in good condition, did quite well, but a late planted crop on the block of new land was not so good. A certain amount was cut for silage but the best lots were left for grain and produced a total of 175 bags. This will provide the greater part of the food required for natives for the coming year.

Kaffir Corn, *Sorghum vulgare*, was not planted till December 15th, which was probably too late to give it a fair chance. Growth started fairly well, but was checked towards the end of January, at which

time aphis was doing some damage. Many of the earliest lots did not pick up well again; the later lots were better, but the general yields were rather poor. It was possible, however, to eliminate a number of the strains planted and to make a selection of the most promising for further trial. Several of the late, strong-growing Indian varieties proved very useful for silage and will be worth growing in special trials for that purpose.

*Oil Seeds.*—The collection of groundnut varieties was again grown in observation plots. Rosette disease did not appear quite so early as in the previous season and did not spread to any extent or cause any appreciable damage. There was a very marked difference in the behaviour of the two types, bunch and runners. The former set a fair crop and were harvested by the end of April. At that time the runners were carrying nothing worth harvesting and all they produced was a very late, miserable crop. The best three bunch varieties, Spanish 9 and 10 and Gudiatham Bunch, averaged just over 1,000 lbs. per acre of unshelled nuts.

Sunflower varieties, grey-striped and black, were planted on observation plots in December, but just missed the moisture and gave a very ragged stand. A one-and-a-half acre field of each was planted later, January 14th, and did fairly well, though it was probably too late to give a heavy crop. The grey gave 1,280 lbs. per acre as against 1,163 from the black, a poorish yield that would only show a small margin of profit with prices low. The thresher with bar beaters, that did the tepary beans well, also did the sunflower heads most satisfactorily.

## Development of Station.

The recent expansion of the Station was referred to in last year's report. A considerable amount of work on general development has been carried out during the season. Many of the new roads and storm-water drains have been put in, though there is still much to be done in connection with the final lay-out.

The first half, 45 acres, of the new arable area was under crop, maize and kaffir corn, last season and showed no undue irregularity. It will be put under some bulk rotation crops again before being used for experimental work in 1930-31. The breaking of the second half was finished early in the season and it has since been re-ploughed and prepared for planting. It will take the whole of the multiplication plots of small cotton bulks in the coming season.

The laboratory is finished and fitted up with the necessary apparatus. It is a most satisfactory building and makes it now

possible for the work to be carried out with efficiency and in comfort. The line for electric current from the town has been put in and the pumping plant is now being installed. Electric power will be used both for pumping and for running two small gins, one of 40 saws for large bulks and one of 16 saws for smaller lots.

A large wood-and-iron shed is under construction and will be finished very shortly. It will provide much-needed storage rooms for large bulks of cotton and rotation crops, also a ginning room for the power gins and storage room for sacks, tools, mealie-meal, etc. A quantity of old building material has been purchased for the erection of an implement shed and this will be started as soon as opportunity arises.

Quarters for Staff are finished and all occupied. Two larger houses and two smaller were built and one smaller one was purchased, all being near together in one group. This provision of comfortable houses within two miles of the station has made a great difference in easing the work, especially at busy times. It had been intended to sell the old Corporation house, on the other side of the town, but this is now occupied by Mr. Ullyett, who has recently been transferred to Barberton.

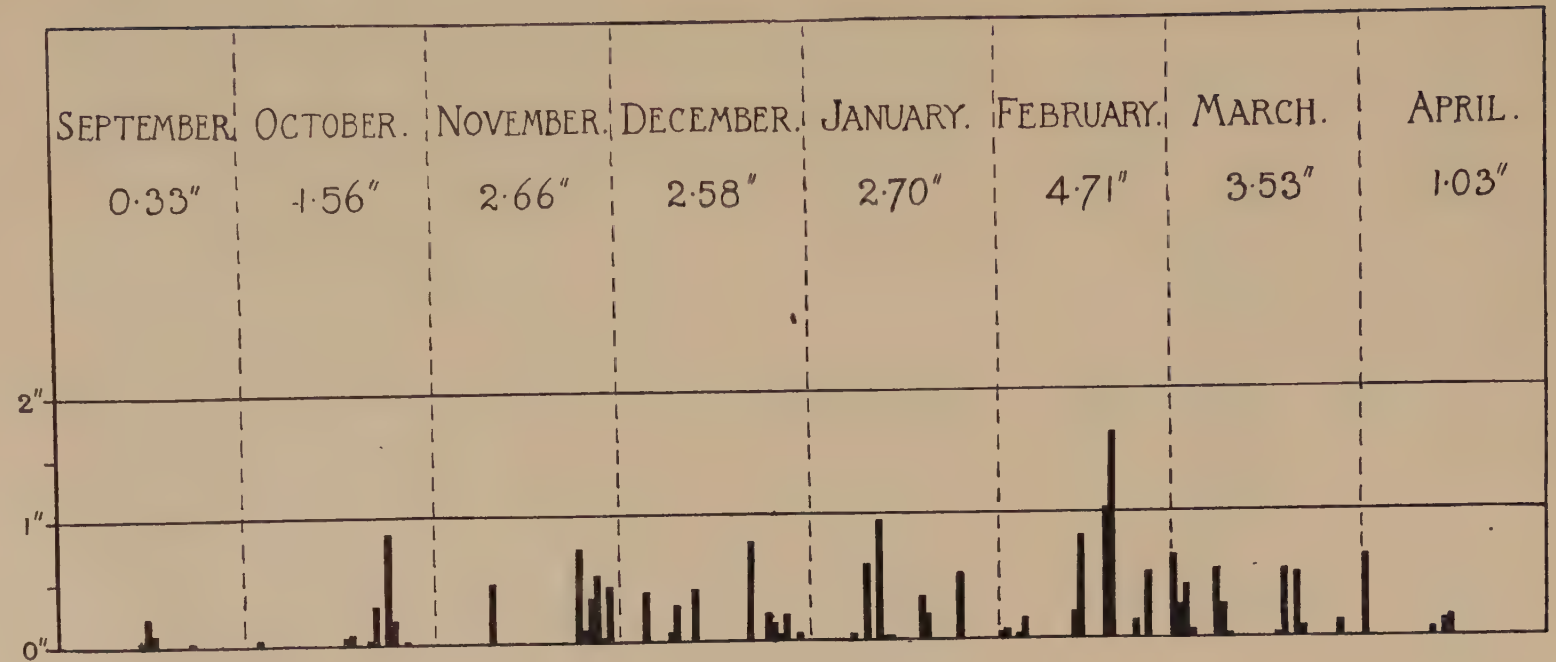
## BARBERTON.

### Daily Rainfall, Season 1928–29.

| | *July.* | *Aug.* | *Sept.* | *Oct.* | *Nov.* | *Dec.* | *Jan.* | *Feb.* | *Mar.* | *Apr.* | *May.* | *June.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 ... ... | — | — | — | — | — | — | — | 0·05 | 0·67 | 0·66 | — | — |
| 2 ... ... | — | — | — | — | — | — | — | 0·07 | 0·27 | — | — | — |
| 3 ... ... | 0·05 | — | — | 0·03 | — | — | — | — | 0·41 | — | — | — |
| 4 ... ... | — | — | — | — | — | — | — | 0·03 | 0·06 | — | 0·03 | — |
| 5 ... ... | — | — | — | — | — | 0·39 | — | 0·17 | — | — | — | 0·17 |
| 6 ... ... | — | — | — | — | — | — | — | — | — | — | — | 0·01 |
| 7 ... ... | — | — | — | — | — | — | — | — | — | — | — | — |
| 8 ... ... | — | — | — | — | — | — | 0·04 | — | 0·55 | — | — | — |
| 9 ... ... | — | — | — | — | — | 0·07 | — | — | — | — | — | — |
| 10 ... ... | — | — | — | — | 0·48 | 0·28 | 0·61 | — | 0·27 | — | — | — |
| 11 ... ... | — | 0·01 | — | — | — | — | — | — | 0·01 | — | — | — |
| 12 ... ... | — | — | — | — | — | — | 0·96 | — | — | 0·07 | — | — |
| 13 ... ... | — | — | — | — | — | 0·41 | 0·01 | 0·21 | — | — | — | — |
| 14 ... ... | — | — | 0·02 | — | — | — | 0·01 | 0·82 | — | 0·14 | — | — |
| 15 ... ... | — | — | 0·22 | — | — | — | — | — | — | 0·16 | — | — |
| 16 ... ... | — | — | 0·08 | — | — | — | — | — | — | — | — | 0·01 |
| 17 ... ... | — | — | — | 0·06 | — | — | — | — | — | — | — | — |
| 18 ... ... | — | — | — | 0·07 | — | — | — | 1·04 | 0·01 | — | — | — |
| 19 ... ... | — | — | — | — | — | — | 0·34 | 1·65 | 0·56 | — | — | — |
| 20 ... ... | — | — | — | — | — | — | 0·20 | — | — | — | — | — |
| 21 ... ... | — | 0·06 | — | 0·01 | — | — | — | — | 0·51 | — | — | — |
| 22 ... ... | — | — | 0·01 | 0·30 | — | 0·79 | — | — | 0·09 | — | — | — |
| 23 ... ... | — | — | — | — | — | — | — | 0·14 | — | — | — | — |
| 24 ... ... | — | — | — | 0·89 | 0·74 | — | — | — | — | — | — | — |
| 25 ... ... | — | — | — | 0·19 | 0·10 | 0·22 | 0·53 | 0·53 | — | — | — | — |
| 26 ... ... | — | — | — | — | 0·35 | 0·14 | — | — | — | — | — | — |
| 27 ... ... | — | — | — | 0·01 | 0·53 | 0·04 | — | — | — | — | — | — |
| 28 ... ... | — | — | — | — | 0·02 | 0·20 | — | — | 0·12 | — | — | — |
| 29 ... ... | — | — | — | — | 0·44 | — | — | — | — | — | — | — |
| 30 ... ... | — | — | — | — | — | 0·04 | — | — | — | — | — | — |
| 31 ... ... | — | — | — | — | — | — | — | — | — | — | — | — |
| Total ... | 0·05 | 0·07 | 0·33 | 1·56 | 2·66 | 2·58 | 2·70 | 4·71 | 3·53 | 1·03 | 0·03 | 0·19 |

Total rainfall for year 19·44 inches.

# Daily Rainfall. Season 1928-29.



# REPORT ON THE WORK OF THE COTTON EXPERIMENT STATION, CANDOVER, MAGUT, NATAL, FOR THE SEASON 1928-29

BY

F. S. PARSONS AND P. A. BOWMAKER.

SUMMARY.

The work on the Experiment Station and in the area proceeded, on the whole, according to plan. An extension of the programme dealing with crops other than cotton was indicated in the previous season's Report, and conditions permitted this increase. A greater number of cotton experiments were laid down in order to meet the needs of testing the additional strains from the Cotton-Breeding Station at Barberton.

The seed from Z cotton strains produced on multiplication fields in the quantities reported last season was distributed for sowing purposes and the main crop was planted with this seed.

The crop made a very late start and suffered heavily from American bollworm in January and February. In many cases this bollworm largely destroyed a good setting of young bolls and buds ; following this, and under good moisture conditions in March and April, the Z cotton plants made large, woody growth at the expense of fruiting, and, in consequence, yields were low. Crops of U.4 cotton, on the contrary, under similar conditions, bore well. Attention is directed to the comparative yields from commercial stands of U.4 and Z.1/9 grown on the Experiment Station (page 67). U.4 seed is available in ample quantities for general sowing in the 1929-1930 season.

The crop produced in the Candover Area was some 9,000 field bales of seed-cotton, the average weight of these bales being approximately 500 lbs. The same approximate figure for crop production was reported last season.

Ratoon cotton yielded very poorly. This may be accounted for, largely, by the nature of the rainfall. Only one soaking rain fell during

the season. This was on January 6th, and the fruiting which followed was mostly destroyed by the American bollworm in the succeeding weeks. The area under ratoon cotton, which suffered in this way, was sufficiently large to cause an appreciable reduction in the expected yields.

## STAFF.

The senior author of this report proceeded on leave abroad in February. On his return to South Africa in August he relinquished his appointment at the Candover Experiment Station and was posted to the staff of the Cotton Breeding Station, Barberton.

## CLIMATIC CONDITIONS.

The season commenced with a good, general, penetrating rain in the middle of September, which was of great value in the preparation of the seed bed. Planting was general following the October rains (vide chart. p. 78), but the portion sown at this time did not represent a large percentage of the whole to be sown. A severe hailstorm occurred on the 26th of the month, which was most destructive to the young crop, necessitating re-sowing in many places. There was a heavy run-off of moisture from the hail so that this was not of much value for growth. Rain did not fall again until a month later. The bulk of the crop germinated on these late November rains. The earlier sown crops were badly in need of this moisture and only commenced making good growth after receiving it. The month of December was very dry until the latter part, with the result that all crops were very late for the time of year. The heavy, sustained rainfall on January 6th promoted excellent growth, however. The moisture conditions for the month were good and growth was very rapid. It was at this time that the American bollworm became active. The infestation was general and heavy, and persisted until mid-February. This was a dry month unfortunately, and fresh fruiting following the cessation of the bollworm attack was not much in evidence until March. At this late date the crop outlook was decidedly poor. As a rule bolls set in late March do not mature, owing to a combination of stainer damage, lack of moisture and colder weather. In the season under review there was ample moisture in March and April and the following months were unusually warm. These conditions enabled the late-set bolls to mature. Stainer damage was not particularly heavy. This is dealt with elsewhere (page 71).

TABLE I.

DAILY RAINFALL.

| *Date.* | *Precipitation. (Inches.)* | *Date.* | *Precipitation. (Inches.)* |
|---|---|---|---|
| | | Brought forward | 13·57 |
| Sept. 15 ... ... | 1·50 | Feb. 17 ... ... | ·10 |
| 16 ... ... | ·80 | 18 ... ... | ·30 |
| | | 19 ... ... | ·85 |
| Oct. 15 ... ... | ·02 | 20 ... ... | ·03 |
| 16 ... ... | ·07 | 21 ... ... | ·20 |
| 17 ... ... | ·25 | | |
| 18 ... ... | ·14 | Mar. 1 ... ... | ·60 |
| 19 ... ... | ·24 | 2 ... ... | ·25 |
| 21 ... ... | ·02 | 3 ... ... | ·01 |
| 26 ... ... | 1·38 | 4 ... ... | ·14 |
| 27 ... ... | ·24 | 5 ... ... | ·05 |
| | | 9 ... ... | ·50 |
| Nov. 24 ... ... | 1·55 | 10 ... ... | ·40 |
| 27 ... ... | ·23 | 11 ... ... | ·12 |
| 29 ... ... | ·53 | 19 ... ... | ·52 |
| | | 21 ... ... | ·34 |
| Dec. 21 ... ... | ·14 | | |
| 22 ... ... | ·15 | April 2 ... ... | ·67 |
| 23 ... ... | ·05 | 13 ... ... | ·77 |
| 24 ... ... | ·05 | 15 ... ... | ·37 |
| 26 ... ... | ·60 | | |
| 30 ... ... | ·71 | May ... ... | Nil |
| | | | |
| Jan. 6 ... ... | 2·85 | June 6 ... ... | ·64 |
| 9 ... ... | ·15 | 7 ... ... | ·14 |
| 10 ... ... | ·10 | 16 ... ... | ·30 |
| 11 ... ... | ·01 | 17 ... ... | ·20 |
| 12 ... ... | ·50 | 18 ... ... | ·05 |
| 13 ... ... | ·15 | 19 ... ... | ·02 |
| 15 ... ... | ·24 | 23 ... ... | ·13 |
| 23 ... ... | ·26 | | |
| 30 ... ... | ·64 | | |
| | 13·57 inches. | | 21·27 inches. |

## SEED MULTIPLICATION.

3,900 lbs. of U.4 seed were distributed for multiplication at the commencement of the season. A considerable proportion of this seed was derived from late crops of the previous year, which suffered a good deal from boll rot. The germinating power of this proportion of seed was impaired, therefore. The weight of seed taken from U.4 multiplication fields was 32,000 lbs. The return of seed is low, as a number of

fields were destroyed by hail and other conditions. This seed has been distributed for the 1929-1930 season. Additional quantities will be required in order to sow the whole area with U.4 seed. Fortunately, there is now ample seed available from the Barberton District, where the main multiplication of U.4 was carried out.

Five strains from U.4 were planted out in small blocks for observation and multiplication under dry land and irrigation conditions. These are referred to in a test for yield later in the Report (page 68).

Plots of Cambodia strains were also set out for observation and multiplication purposes. None of this seed is being distributed, however.

Seed from 149 single-plant selections, taken in U.4 at Barberton, was sown in progeny rows at Candover. This was done as an insurance should weather agencies destroy any of the selections at the Barberton Station, and in order to see their behaviour in a somewhat different environment.

It is of considerable interest to note the returns from multiplication areas of U.4 on the Experiment Station, viewed in conjunction with the weather and American bollworm attack, to which reference has been made.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Block 4 | ... | ... | ... | ... | 704 lbs. | seed | cotton | per acre. |
| 6 | ... | ... | ... | ... | 786 „ | „ | „ | |
| 8 | ... | ... | ... | ... | 934 „ | „ | „ | |
| Single Plant Selections | | | ... | ... | 1,210 „ | „ | „ | |

Blocks 4 and 6 were very heavily infested with the bollworm. Block 8 was five weeks later than Blocks 4 and 6 and encountered less bollworm. The single-plant selections lost most of the buds and young bolls from bollworm, so that the crops on these blocks were derived to a very large extent from buds set late in February. It is very unlikely that the U.4 cotton would have yielded well had the weather not remained warm and moist, but such fruiting behaviour was not seen in other cottons, these making vegetative growth mainly. In one instance, however, a block of Z.1/9 cotton on the Experiment Station, which suffered less from Bollworm, returned a yield of 860 lbs. per acre.

### SELECTIONS—CAMBODIA COTTON.

The selections retained from the previous season were sown for observation only. The Barberton Station received most of the seed from these at the commencement of the season and further selection work has been carried out there.

## EXPERIMENTAL WORK.

### Cotton.

The experimental work with cotton consisted mainly of variety and spacing tests. An experiment in topping U.4 cotton plants was also carried out. This was done as part of an investigation into measures which might be adopted with a view to bringing a late-planted crop into earlier fruition. Close spacing, early thinning, and topping were considered as possible measures. In the case of topping the results from 11 comparisons were as follows :—

Topped rows, 874 lbs. per acre ; rows not topped, 818 lbs. per acre, with a ratio of the standard error to the mean difference of 1·54. Considering the prolonged growing conditions of the season, the plants not topped were given an opportunity to ripen off a crop which would not occur in most seasons, so that the results are more suggestive than the figures indicate : the topped plots did produce earlier. Close spacing and early thinning both make for earlier ripening also. Thinning when the plants are about 6ins. to 8ins. high is carried out as a general practice now, whereas formerly they were allowed to attain a height of about 12ins. before the operation was considered necessary. In the presence of certain seedling pests here, it is considered inadvisable to thin out very small seedlings, except by the action of the broad-tined riding cultivator operating across the rows, which leaves the seedlings in small groups to be thinned later by hand. Close spacing does not seem advisable. This is referred to in the remarks on spacing trials.

### Variety Trial Yields—Jassid-resistant Strains.

This experiment was originally set out in the same way as the variety trial at Barberton and Bremersdorp. The plots were ruined by irregular germination and it was necessray to sow another series on a smaller scale. The plots consisted of 8 rows each, 4 rows only were used for yield data. At picking time the rows were dealt with as follows :—Rows 2 and 3 were picked together for comparison with rows 6 and 7 of an immediately adjacent standard plot on the left, rows 4 and 5 were used as observation rows throughout the season, rows 6 and 7 were picked together for comparison with rows 2 and 3 of the immediately adjacent standard plot on the right, rows 1 and 8 were discarded as outside rows. There were plots of a standard for comparison on each side of each plot of the varieties under test. The standard used was U.4 Bulk.

TABLE II.

YIELDS—VARIETY TRIAL—JASSID-RESISTANT STRAINS.

| *Variety.* | *Yields. Lbs. Seed Cotton per Acre.* | $\frac{\overline{d}}{\epsilon_d}$. | *P.* |
|---|---|---|---|
| A.12 ... ... ... ... ... ... | 764 | Standard for | comparison |
| U.4 ... ... ... ... ... ... | 903 | 1·82 | ·069 |
| Z.1/9 ... ... ... ... ... ... | 621 | 3·54 | — |
| Z.H ... ... ... ... ... ... | 621 | 1·83 | ·068 |

$\frac{\overline{d}}{\epsilon_d}$. = ratio of the standard error to the mean difference.

*P.* = probability integral.

The plots experienced an infestation of the seedling beetle *Syagrus rugifrons*, Baly. The main effect of this was to retard growth over certain patches. The effect persisted throughout the season and undue weight was given to deviations from mean yields in consequence.

TABLE III.

PERCENTAGES OF THE TOTAL CROP PICKED AT VARIOUS REAPING DATES.

| *Variety.* | *Reaping Dates.* | | | | | | |
|---|---|---|---|---|---|---|---|
| | 13/5 | 21/5 | 28/5 | 3/6 | 10/6 | 1/7 | 25/7 |
| A.12 ... ... | 7·7 | 21·3 | 35·4 | 51·9 | 65·3 | 91·0 | 100·0 |
| U.4 ... ... | 13·3 | 25·7 | 39·5 | 53·3 | 65·0 | 91·6 | 100·0 |
| Z.1/9 ... ... | 5·7 | 14·9 | 24·8 | 38·2 | 50·3 | 87·0 | 100·0 |
| Z.H. ... ... | 12·8 | 27·0 | 41·6 | 54·8 | 65·4 | 91·0 | 100·0 |

The jassid fly was not abundant at any time during the season, but it was present in sufficient numbers to affect the Z.H. (so-called Zululand Hybrid) cotton. This was included in the test for observation purposes when the jassid fly came into the cotton, as it is notably susceptible to its attack. The earliness of the Z.H. cotton was the result of jassid attack, the bolls being stimulated to earlier ripening and to some extent to premature splitting of the boll. The Z.1/9 cotton fruited poorly for the reasons already stated in the introductory remarks.

VARIETY TRIAL—Z.1 STRAINS.

The following re-selected strains of Z.1 were tested against the Z.1/9 cotton which was distributed to the farmers at the close of last season :—Z.1/15, Z.1/14, Z.1/9.

The seed was derived from self-fertilized material.

Z.1/14 was not included in the test reported last season. The yields of these strains during the present season were practically identical, and they were indistinguishable during growth.

### Variety Trial—U.4 Cotton Strains.

Small quantities of seed of the following strains were received from the Barberton Station to be multiplied and tested in the Candover district. The quantity of seed available for the test was limited so that plots in triplicate only were set out. These were arranged for comparison on the half-drill strip method. U.4 Bulk was included as a standard for comparison ; plots of this bounded each side of each plot of the strains tested.

TABLE IV.

| *Strain.* | *Yield Lbs. Seed Cotton per Acre.* | $\frac{\bar{d}}{\epsilon_{\bar{d}}}$ | *P.* |
|---|---|---|---|
| U.4/4 ... ... ... ... ... ... | 1,196 | 6·09 | — |
| U.4/2 ... ... ... ... ... ... | 1,116 | ·975 | — |
| U.4/6 ... ... ... ... ... ... | 1,071 | — | — |
| U.4 Bulk ... ... ... ... ... | 1,071 | Standard | — |
| U.4/5 ... ... ... ... ... ... | 1,062 | — | — |
| U.4/3 ... ... ... ... ... ... | 1,022 | 1.94 | ·053 |

The yields from these strains are much like those obtained at Barberton and Bremersdorp.

### Cotton Spacing Trials—Z.1/9 Strain.

The Z.1/9 strain was taken for trial again, as this strain was supplanting other Z material for general seeding purposes pending reports on U.4 and the provision of U.4 seed.

The spacings adopted for testing, as in the previous season, were 6 ins., 12 ins., 18 ins. and 24 ins. in the drill with an inter-row distance of 3 ft. 6 ins. The plots were 1/40 acre areas. There were 4 repetitions of the 6 ins., 12 ins., and 24 ins. treatments. The 18 ins. treatment was used as a standard for comparison. These plots of the standard bounded each side of all plots of the other spacing intervals so that comparisons with the standard could be made adjacently.

TABLE V.

| *Treatment.* | *Yield in Lbs. Seed Cotton per Acre.* | $\frac{\bar{d}}{\epsilon_{\bar{d}}}$ | *P.* |
|---|---|---|---|
| 6″ spacing ... ... ... ... ... | 522 | 5·2 | — |
| 12″ ,, ... ... ... ... ... | 607 | — | — |
| 18″ ,, ... ... ... ... ... | 622 | Standard | — |
| 24″ ,, ... ... ... ... ... | 579 | 2·04 | ·044 |

The plots were sown in complete rows and these were thinned to the required interval when the plants were 6 ins. in height. The infestation of American bollworm in January and February destroyed the early settings of fruit. The month of February was very hot and moisture was difficult of access until during the third week. Prior to this rainfall the wilted condition of the plants at the 6 ins. spacing was most noticeable. On plants in the other treatments fruiting recommenced towards the end of February, but the available moisture was insufficient to meet the requirements of the plant at 6 ins. intervals. Buds were not laid down on these following the February rain, and wilting was pronounced again. The unusually warm weather late in the season and good late moisture conditions enabled all spacings to produce a fair crop, but it was seen that only these unusually favourable circumstances permitted the plants at the closest spacings to make a crop.

The complete loss of fruit from a mid-season infestation of American bollworm is not uncommon and the occurrences of the past season show that close spacing is inadvisable.

### COTTON SPACING TRIALS—U.4.

Previous observations had shown that U.4 plants were definitely too close when spaced at 6 ins. intervals. The spacings adopted for trial in the present instance were 12 ins., 18 ins., and 24 ins. The 18 ins. spacing was used again as a standard for comparison. There were six repetitions, thus allowing twelve comparisons with the standard on the half-drill strip method under which the plots were laid out. The plots were 1/40 acre areas.

The seed was sown in complete rows, using a small seeder of the Planet Junior type, known as the Iron Age Seeder. The plants were thinned out to the required interval when they were 6 ins. high.

The seed sown was taken from the U.4 bulk material which is being distributed for general seeding purposes. This gives rise to a very mixed plant population, and the even yield figures from the various treatments suggest that the differences in plant habit are given sufficient expression at the different spacings to cause a somewhat levelling effect on the yields over the whole.

TABLE VI.

YIELDS—SPACING TRIALS—U.4.

| *Treatment.* | *Yield Lbs. Seed Cotton per Acre.* | $\frac{\bar{d}}{\epsilon_d}$ | *P.* |
|---|---|---|---|
| 12″ spacing ... ... ... ... ... | 874 | 1·14 | ·263 |
| 18″ ,, ... ... ... ... ... | 899 | Standard | — |
| 24″ ,, ... ... ... ... ... | 908 | ·59 | ·555 |

The plots at the 12 ins. spacing treatment suffered most from moisture shortage in the mid-season, and would have yielded poorly had there not been the late rains and sustained warm weather late in the year this season. A spacing wider than 24 ins. should be included in future trials. Spacing trials are now required using strains selected from the bulk U.4 material so that, as these are uniform in plant habit, they may be studied to better advantage.

### Cotton Spacing Trials—Z.106 Cotton.

The spacing trials reported last season were continued on essentially the same plan, but with six rather than four replications of Z.106 plots. It would seem from its close, upright habit that Z.106 cotton should be well adapted for close spacing both in the drill and in between the rows.

Two experiments were set out in which the drill interval was 6 ins. in each case, but in one case the inter-row distance was reduced to 2 ft. 6 ins. and in the other 3 ft. as against the usual 3 ft. 6 ins. adopted for other cottons. The plots were set out on the half-drill strip method for comparison with a standard, Z. 1/9. The standard was placed at 18 ins. in the drill, with an inter-row distance of 3 ft. 6 ins., this being the ordinary spacing. Suitable provision was made in guard rows for the differences in spacing, both drill and row, of the adjacent plots.

The yields are given in Table VII. The Z.106 seed was taken from a mixed bulk quantity, this being the only seed available, and the resulting plants were not, on the whole, of the very narrow upright type which has been selected from it. In view of this the plots did not measure the behaviour of the type of plant illustrated as Z.106 in the Report from the Cotton-Breeding Station, Barberton, 1926-1927. The value of the yield figures is much reduced as a result of the departures from plant type in these plots.

The small boll associated with Z.106 persisted, however. These do not open fully and as a result picking difficulties are increased.

At the present time the seed position and other considerations do not warrant the continuation of the trials.

TABLE VII.

Yields—Spacing Trials—Z.106 Cotton.

| *Treatment.* | *Yields Lbs. per Acre Seed Cotton.* | $\frac{d}{d}$ | *P.* |
|---|---|---|---|
| Z.1/9 ... ... ... ... ... ... | 525 | Standard | — |
| Z.106— Drill interval 6″ ; inter-row distance 2′ 6″ | 421 | 6·6 | — |
| Z.106— Drill interval 6″ ; inter-row distance 3′... | 489 | 1·58 | ·114 |

PESTS AND DISEASES.

*Sudan Bollworm* (*Diparopsis castenea*, Hamps.).—The infestation in the Spring months was unusually light and showed a very gradual increase in the ratoon cotton. During January, however, fairly large numbers were in the ratoon cotton. This had to compete then with the heavy attack of the American bollworm, to which frequent reference has been made, and the feeding activities of these two pests very largely destroyed the ratoon cotton crop. There was, however, practically no Sudan bollworm in the trap rows on the Experiment Station, and these were cut out in January. The lateness of plant cotton meant a practical absence of fruiting until January. There was little Sudan bollworm evident in this when the American bollworm arrived, and no doubt the cannibalistic habits of the latter accounted for a reduction in number of the former.

The Sudan bollworm became present in very noticeably increased numbers in March and April, as in former years, and in some cases caused heavy damage to late crops.

The course of the infestation during the early season permitted very little light trapping data. Acetylene flares and paraffin oil lamps were put in operation during March and April on the Experiment Station area. Captures of 11 to 50 moths per flare per night were recorded during part of the month of April. The percentages of females caught at lights varied from 30 to 50% of the totals caught. These were invariably gravid.

*Cotton Stainers* (*Dysdercus spp.*).—The stainers appeared in April about the same time of year as reported last season. They multiplied rapidly under good breeding conditions, being most abundant during May.

A time-of-planting experiment with cotton, designed to ascertain if early plantings ripen a large percentage of the crop before the stainer arrives in numbers, was carried out again. The mid-season loss of buds and young bolls from bollworm attack made all plantings late in setting the crop which was ultimately harvested, so that actually results were not secured from such early plantings as the seasonal conditions allowed. The percentages of stained cotton reaped from five planting dates were as follows :—

PERCENTAGES OF STAINED COTTON—TIME-OF-PLANTING EXPERIMENT.

| *Sowing Dates.* | *Percentages of the Crop Stained.* |
|---|---|
| October 29th ... ... ... ... ... | 42 |
| November 27th ... ... ... ... | 49 |
| December 12th ... ... ... ... ... | 44 |
| December 28th ... ... ... ... ... | 62·5 |
| January 10th ... ... ... ... ... | 77·6 |

The first three plantings should be considered practically as one owing to the nature of the season and the conditions brought about by the attack of the American bollworm, particularly the latter. This meant that the fruit which produced the earliest crop was laid down as late as February. No cotton was reaped until mid May, which, for the October planting, was two months late.

*American Bollworm* (*Chloridea obsoleta*, Fabr.).—This bollworm has caused little damage in this district in previous seasons. In the season under review it appeared in large numbers in January and February, and, as noted throughout the Report, was largely responsible for ruining the ratoon cotton crop and greatly reducing the yield from Z plant cotton.

*Leaf Eating Beetle* (*Syagrus rugifrons*, Baly.).—The continuous planting of cotton to the exclusion of other crops, and the extension of ratoon cotton farming has offered every facility to the increase and spread of this beetle, so that, nowadays, it has assumed the position of a major pest of cotton in this area.

In previous reports it has been noted that the beetle winters over as the adult and attacks the first emerging seedlings. Calcium arsenate dust and other stomach poisons kill the beetle when properly applied on seedling cotton. Growers are now urged to plant a few rows of cotton with the earliest growing rains of the Spring, even though over roughly prepared ground, *i.e.*, Winter or Spring ploughed only, in order to attract the beetle to these few rows of cotton before the main crop is planted, and to poison them by dusting heavily these relatively small areas. It has been observed that the beetle concentrates on volunteer cotton plants early in the Spring or late Winter, and it is believed they will do likewise in large numbers on the trap rows. In fact it has been demonstrated that they will concentrate quickly and in numbers on small patches of the earliest cotton, and furthermore, that they do not seem to wander away in search of other food supplies even though this is adjacent during the period of feeding and breeding.

The trapping proposals involve little expense and labour, and as it appears from all points of view to be a ready, practical measure, it should be tried out without delay by all farmers who have beetle infested land. The proper preparations of the seed bed for the main planting are not interfered with if the trap rows are not sown across the direction of future tillage.

### Rotation Crops.

*Sorghums.*—All attempts to produce grain from the range of sorghums grown were frustrated by the attacks of the maize stalk borer (*busseola fusca*, Fuller). It is believed that the infestation on

the Experiment Station arises in the first instance from adjacent patches of native grown maize and sorghum. Elsewhere in the neighbourhood plots of sorghum are grown with a minimum of borer attack, so that trials must be carried out elsewhere in the area pending an investigation of the supposed reservoirs of infestation and measures to deal with them. Every plant appeared to be badly affected. The sorghums suffer more from the attacks of the borer than does maize. In the case of the latter growing during the same period, a record crop was harvested, although in practically every plant examined the borer was found.

*Pit Silage.*—A first trial of ensiling maize in a pit was carried out. The variety of maize known as German Yellow was grown for this purpose, being cut when the grain was in the milk stage. This was the first attempt to make silage in this or any other manner in the area, and the measure was adopted with a view to providing a reserve of food material for working cattle should the winter pasturage be short, and to see if it might be relied upon by growers who are now making a business of shipping their cream to provincial markets. The silage has not been needed for draught oxen during the present winter, as late rains and warm weather have maintained good grazing. However, on examination it proved to be excellent silage with a minimum of "firing" and the method may be recommended.

*Sunflowers.*—The work with sunflowers, a promising crop, consisted of a yield trial between a black and a grey striped seed variety. Seed of these two is commonly sown and as it may be some time before better material is available, it appeared advisable to assess their relative yielding powers. A spacing trial, and growth of the crop on a field scale to study its management during growth, reaping and harvesting were carried out.

*Sunflower Variety Trial.*—The lay-out of the plots permitted 14 comparisons on the half-drill strip method. The differences in yield between the two varieties were so wide and regular that estimations of the standard deviation are omitted. The yields were as follows :—

TABLE VIII.

| *Variety.* | *Yield Lbs. per Acre.* |
|---|---|
| Striped Russian ... ... ... ... ... | 1,348 |
| Black ... ... ... ... ... ... | 830 |

The striped variety was three weeks earlier. This earlier maturation most probably influenced the larger seed production of the striped variety under the growing conditions experienced, and comparative time-of-planting experiments are needed to assess yield behaviour. Furthermore, it must be added that there are probably different strains of both these varieties available from seed merchants (the present source of supply) though unspecified or unknown as such.

Threshing implements were not available at Magut for trial in threshing the heads from the field crop, but it was found at Barberton that a small pattern of a beater thresher suffices very well, and information is now to hand of larger implements specially designed for threshing sunflowers.

On the whole the crop appears to be suited to the district and the work will be extended on the provision of other varieties and selections for trial.

*Sunflower Spacing Trials.*—The inter-row distance only was tested. These were 2 ft. 6 ins., 3 ft. and 3 ft. 6 ins. The drill interval was 18 ins. in all plots. It was realised later that this might have been varied with probable advantage, as in the first instance a drill interval of 18 ins. is rather wide and the size of heads varies with root room. The plots were not retarded by lack of moisture, so that their behaviour under dry conditions was not observed. The plants at the closest spacing produced smaller heads, smaller seeds and shorter stems, and flowered 4 days earlier. The yields are given below:

TABLE IX.

SUNFLOWER SPACING YIELDS.

| *Treatment.* | *Yields Lbs. per Acre.* | $\frac{d}{\epsilon_d}$ |
|---|---|---|
| 2′ 6″ inter-row spacing ... ... ... ... ... | 1,289 | ·17 |
| 3′ „ ... ... ... ... ... | 1,277 | Standard for comparison |
| 3′ 6″ „ ... ... ... ... ... | 1,246 | 1·93 |

*Groundnuts.—Yield Test and Observation Rows.*—The work with groundnuts in previous seasons consisted of planting out observation rows of as many varieties as were procurable. The crop had not been grown in the area as a field crop and it was hoped to find amongst the introduced material something that would produce good crops. In the previous season 32 varieties were grown, of which it was possible to eliminate a number from further consideration. There remained 21 and it seemed advisable to plant these out for a test of yield as well

as for observation. The plots were randomized and in quadruplicate. Eighteen of these varieties yielded at the rate of over 20 bags (70 lbs.) to the acre, with a low standard deviation. The highest yielding lot was an upright Spanish variety bearing a small nut. This produced at the rate of 27½ bags to the acre. As a result of the test it is possible to eliminate many of the varieties, especially of the procumbent form, as these require a longer growing period and are more difficult to handle in harvesting and stripping. Among the varieties are a few which produce large kernels which should be more suitable for certain trade purposes, and, although they do not yield as well, may command a better sale on export markets.

Rosette disease is a determining factor in some areas, but so far it has not been at all prominent on the Station for the past three years, and it appears advisable to continue the work with groundnuts as remunerative yields may be expected.

*Groundnut Cultivation.*—The soil of the Experiment Station is a well broken down shale loam, which does not pack except following on heavy downpours of rain. Pegging and lifting of the crop ordinarily should offer no impediment. The value of ridging the crop seemed open to question from observations which had been made and it was decided to study the behaviour of rows ridged and rows flat. A test was conducted permitting 22 comparisons of the treatments, with the following results :—

TABLE X.

GROUNDNUT CULTIVATION.

| *Treatment.* | *Yield Lbs. (Undecorticated) Nuts per Acre.* | $\frac{\bar{d}}{\epsilon_{\bar{d}}}$ | *P.* |
|---|---|---|---|
| Flat cultivation ... ... ... ... | 1,347 | — | — |
| Ridged cultivation ... ... ... ... | 1,142 | 2·17 | ·03 |

A Virginia Bunch variety was used. The flat cultivation was performed with a spring tine pony cultivator which exerts a minimum of ridging or troughing effect while leaving the top well stirred up. The ridging was done, when required, with a groundnut and potato ridger having adjustable wings.

The test should be continued in other seasons and on other soils in the neighbourhood.

*Soya Beans—Yield Trial.*—The 12 varieties secured in the previous season, which were grown then in observation rows, were

planted out in a comparative yield trial, as, although differences in maturation and shattering were observable, it was not possible by inspection only to eliminate any varieties on account of low seed production.

The plots permitted six comparisons. The beans were sown in rows 2 ft. 6 ins. apart and approximately 6 ins. in the drill. It seems probable that an inter-row distance of 2 ft. would be more suitable.

The yield data are not included as shattering behaviour was found to be of greater importance. The actual weights harvested from nine of the plots differ little. The remaining three were outstanding by comparison, and one of them, a yellow-seeded variety, known as Southern, did not shatter the seed, although harvesting was delayed in order to observe the power of retention of the seed exhibited by the variety. This is regarded as promising.

The soya bean nodule-forming organism is not present in the soil and inoculant material was not procurable last season, so that larger crops may be expected from treated seed in the season to follow. The maximum yield obtained was 1,022 lbs. per acre.

*Tepary or Pearl Bean* (*Phaseolus acutifolius*).—These beans which have been outstanding in previous seasons were grown on a field scale and yielded 1,275 lbs. per acre. There are no unusual difficulties in reaping and threshing the crop. It is inexpensive to work as a crop and the beans have a ready sale on interior markets. Investigation is needed on the best sowing distances, or it may be found more profitable to broadcast the seed. In the meantime farmers are taking seed for sowing and it appears that the crop will be given a regular place in the farming system. This could not assume the proportions of a main rotation crop, however, without finding profitable overseas markets for surplus quantities.

*Observation Rows—Beans, Lentils, etc.*—A wide range of beans are in demand on interior markets at attractive prices. All of these have been grown on the Station in different seasons and at different planting dates. Various diseases and pests have been of sufficient magnitude to destroy the crops or plants on each occasion, so these have been abandoned as possible rotation crops, with the exception of soya and pearl beans, as above. It may also be possible to grow crops of the Lima Bean on further study of its growth requirements. Disease, at least, is not, it appears, a limiting factor in this case.

A variety of a large lentil showed promise during the present season. This was grown for the first time in the area. It was free from disease and pests, and by alteration of planting arrangements

from those adopted in this first trial may be found suitable as a field crop.

*Green Manures.* — *Buckwheat* (*Fagopyrum esculentum*). — Lands destined for cotton requirements in the following season were sown to the Japanese variety of buckwheat, broadcasted. This was ploughed in and the land left fallow. The crop was ready to be ploughed in as a green manure in seven weeks from seeding. The green weight per acre at this time was 10·6 tons ; the dry weight, including roots, being 1·4 tons per acre. Decomposition of the plant material is very rapid.

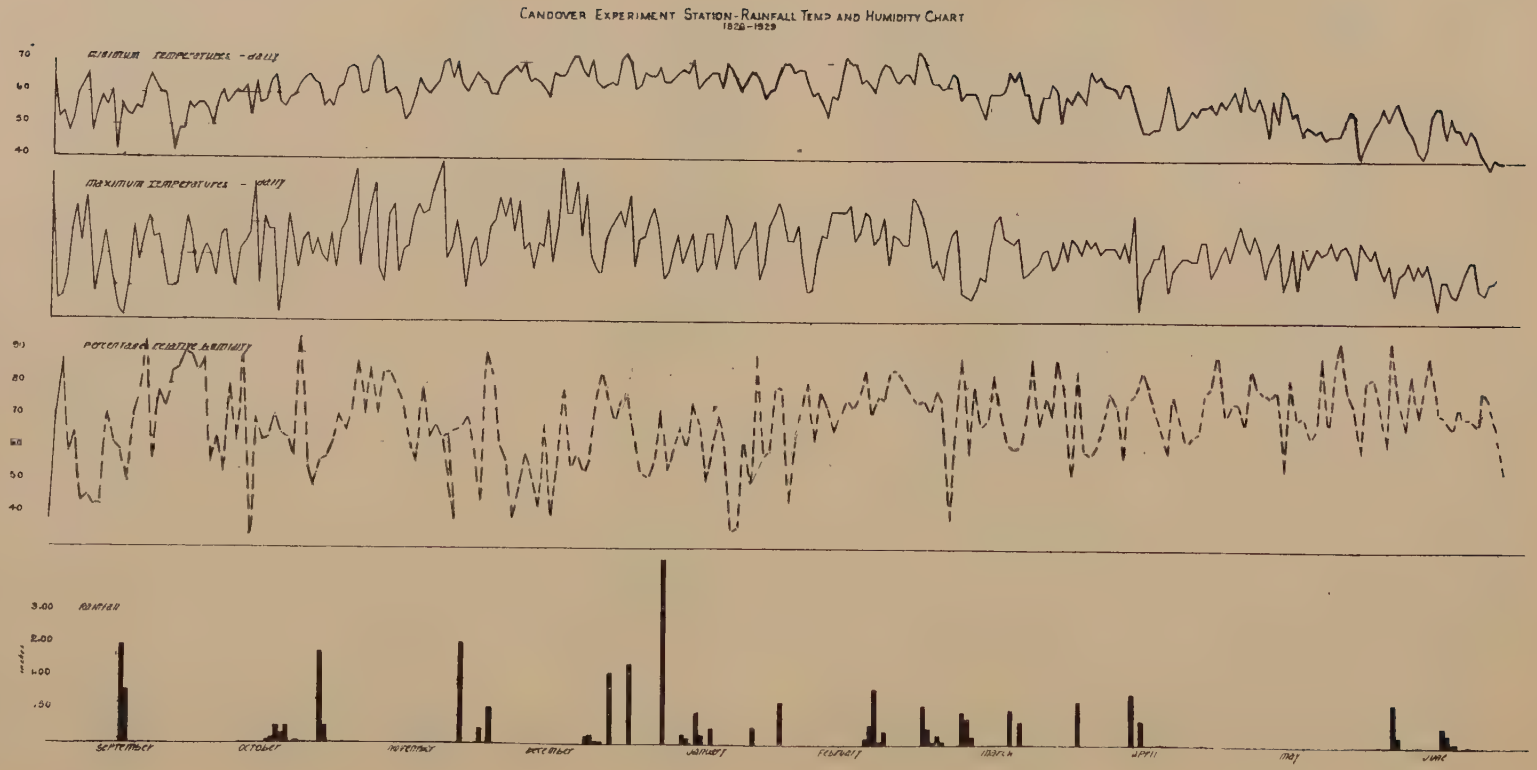
The crop has grown well in different seasons under difficult growing conditions. The benefit that the succeeding cotton crops may derive is now a matter for close observation. The biological activity in the soil and the increased absorption and retention of moisture that should follow the decomposition of this crop is highly desirable in many soils of the district and it is expected that results will show nothing of the unfavourable retardation of plant growth which has occurred in lands that have lain under bare fallow conditions throughout the long growing season.

### BARE FALLOWING PRACTICE.

In connection with the observed retardation of the cotton plants following a period of bare fallow, fields on the Station have been set aside for management, so that cotton crops follow the fallow and will permit investigations to be made over a period.

### CONTINUOUS CROPPING OF COTTON.

An area to be utilized for successive crops of cotton has been set aside in relation to schemes for alternative cropping. This has borne cotton for six years in succession.


CANDOVER EXPERIMENT STATION - RAINFALL TEMP AND HUMIDITY CHART
1828–1929
MINIMUM TEMPERATURES - daily
MAXIMUM TEMPERATURES - daily
PERCENTAGE RELATIVE HUMIDITY
RAINFALL
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE

# REPORT ON THE WORK AT THE INGWAVUMA SUB-STATION, SWAZILAND

BY

F. S. PARSONS.

## Introductory.

The Sub-Station, which was prepared in readiness for the previous season, 1927–1928, is situated in Southern Swaziland. It serves as an area on which to test the behaviour of strains of cotton issued by the Plant Breeding Station, Barberton, to test the suitability of various rotation crops and farming methods, and for experimental and demonstration purposes as far as circumstances permit.

The climatic conditions are somewhat different in this portion of the Low Veld, and it is believed that the plots on the Sub-Station are affording useful information to Estates and individuals engaged in cotton farming. The number of these may be expected to increase, as road and rail facilities have recently been largely extended.

The crop in the present season was very late, having experienced germination and early growth conditions similar to those reported from Candover. The heavy mid-season attack of the American bollworm was experienced in this area, and the remarks in the Candover report on the influence exerted on the crop by the bollworm infestation fully apply in this case to the main crop. The late rains (*see* Rainfall, Table I) were rather better than those elsewhere and a combination of good moisture and warm weather through the winter months allowed the plants to ripen late-formed bolls so that the yields were better than usual in some cases.

U.4 cotton gave high yields, outstandingly high in comparison with other strains, and is no doubt well suited to the district.

The full programme of work at the Station could not be carried out owing to the climatic conditions, but some results are reported from cotton and rotation crop experiments.

TABLE I.

DAILY RAINFALL.—INGWAVUMA.

| | | *Inches.* | | | *Inches.* |
|---|---|---|---|---|---|
| September | 15 | 2·50 | January | 13 | 1·20 |
| ,, | 16 | ·18 | ,, | 20 | ·25 |
| October | 16 | ·20 | ,, | 23 | ·02 |
| ,, | 17 | ·30 | ,, | 24 | ·16 |
| ,, | 22 | ·35 | ,, | 31 | ·31 |
| ,, | 25 | ·75 | February | 3 | ·08 |
| November | 25 | ·78 | ,, | 5 | ·27 |
| ,, | 29 | ·23 | ,, | 16 | ·10 |
| ,, | 30 | 2·00 | ,, | 18 | ·15 |
| December | 6 | ·14 | ,, | 19 | ·30 |
| ,, | 20 | ·27 | ,, | 21 | ·33 |
| ,, | 21 | ·30 | March | 1 | 1·03 |
| ,, | 24 | ·90 | ,, | 3 | ·93 |
| ,, | 26 | 1·52 | ,, | 9 | ·98 |
| ,, | 28 | ·40 | ,, | 10 | ·58 |
| January | 6 | 1·40 | ,, | 11 | ·07 |
| ,, | 12 | ·10 | ,, | 12 | ·58 |
| | | | April | 1 | 1·20 |

Total for season=20·86 inches.

## EXPERIMENTAL WORK.

### COTTON.

*Variety Test—Jassid-resistant Strains.*—The following three strains of jassid-resistant cotton were included in a test for yield and growth behaviour—A.12, U.4 and Z.1/9. A commonly grown mixed cotton known as Uganda was included for comparison should the jassid fly invade the plots. These were in quadruplicate.

Germination occurred at the end of November. The subsequent growth until mid-January was very slow, and as moisture was moderately abundant in December this was attributed to a retarding effect on plant growth that was in evidence everywhere where crops were sown on land which had lain as a bare fallow throughout the previous season. These plants were so slow in coming into fruit that the main attack of American bollworm was over before they were susceptible to damage from it. They did, however, suffer rather heavily from the Sudan bollworm in late February and March. The yields are given in Table II.

TABLE II.

VARIETY TEST—JASSID-RESISTANT STRAINS.

| *Variety.* | *Yield lbs. seed cotton per acre.* | $\frac{\overline{d}}{\epsilon_d}$. |
|---|---|---|
| A.12 | 341 | Standard for comparison |
| Z.1/9 | 253 | 3·8 |
| Uganda | 387 | 1·98 |
| U.4 | 550 | 7·01 |

Jassid fly was not abundant, so the relative resistance of the three strains and the local cotton, Uganda, was not demonstrated as markedly as it was elsewhere.

*Spacing Experiment—U.4 Cotton.*—The plants in these plots experienced the early retardation referred to above. Although planted on the 26th November they were not more than 6 inches high on January 6th. Thereafter they made reasonably steady growth, and set a late crop which ripened under the unusually favourable weather conditions of the early winter months.

There were three treatments of the drill interval only. These were 12-inch, 18-inch and 24-inch. The plots were sown in quadruplicate except those at 18-inch. Plots at this interval were arranged on both sides of each treatment of 12-inch and 24-inch, and comparisons with the 18-inch treatment, as a standard, were made adjacently as for half-drill strips.

The results are given in Table III. Here, as in the yield figures reported for this experiment at Candover, there is no significant difference, and the explanation suggested in that case is believed to apply and to receive some confirmation in the present case—namely, the adaptation of a mixed population of plants with widely differing habits of growth to the available root room.

TABLE III.

SPACING EXPERIMENT—U.4 COTTON.

| *Treatment drill interval.* | *Yield lbs. per acre seed cotton.* | $\frac{d}{\epsilon_d}$ |
|---|---|---|
| 12-inch spacing ... ... ... | 669 | ·126 |
| 18-inch „ ... ... ... | 688 | — |
| 24-inch „ ... ... ... | 687 | ·406 |

*Time of Planting—Cotton.*—This experiment was set out chiefly to ascertain if early-planted cotton crops suffer less from staining and boll rot than later plantings, as would appear to be the case from general observations on the time of year that the stainer bugs are first seen to be abundant in the cotton lands.

In the season under review the earliest planting date was November 29th. This is considered to be about as late as cotton may be planted with expectation of reaping a full crop. In the present season, however, plantings made a month later gave a full crop. This is explained by the practical absence of cold weather for the winter months, and good late rains.

The stainer bugs entered the cotton in numbers in April, about a fortnight to three weeks later than usual. As all the cotton was late and fully exposed to damage no conclusions could be drawn from the experiment in connection with staining.

*Cotton Thinning Experiment.*—The experiment was planned as a continuation of the work dealing with the effect of thinning out the rows of cotton at different stages of growth.

The plots were planted on December 6th, but failed to germinate until after rains at the end of the month. The subsequent growth was so slow and the season so late that the experiment was utilised for qualitative tests of measures that might be adopted to hasten the fruiting of late cotton crops. These measures were combinations of early thinning with various spacing intervals, and the results indicate that work on these lines should provide useful information. Topping of the plants should be included in future trials.

### ROTATION CROPS.

Farmers in the area have devoted considerable acreages to the growth of a number of crops other than cotton, although cotton is the major crop. Practically all the rotation crops at present under consideration are known to them and have been grown on a field scale, with the exception of soya beans and pearl beans. The results have been variable and prices erratic, but on the whole, from the point of view of the permanent position of cotton-growing, the position is somewhat more advanced here than where cotton is grown continuously on the same land.

The trial of numerous varieties of the various possible crops at present known has been the main part of the work with rotation crops so far. The seed sown on farms locally is procured somewhat on chance as a rule, and better material should be available as a result of the growth trials and multiplication of the best varieties at the Station.

*Groundnuts.*—Fourteen varieties were planted out in a test for yield and growth behaviour. They produced their crops during the latter portion of the season, and experienced rather more favourable conditions than may be expected ordinarily. The yields ranged from 21–30 bags (70 lbs.) per acre. A separation of erect and procumbent varieties was not made, however, and edge effects entered into questions of yield. The results encourage the belief that suitable high-yielding strains of groundnuts are available in the material which is being tested.

*Sunflowers.*—The two commonly grown black and striped-seeded varieties were tested for yield. The yields are given in Table IV.

The striped-seeded variety commonly known as Russian Grey matured three weeks earlier. These are the only two lots which have been grown to date, but seed from a number of others has been procured from abroad, and the work with sunflowers is being extended, as the crop appears to be suitable for the conditions of the area.

TABLE IV.

SUNFLOWER VARIETY TRIAL.

| *Variety.* | *Yield lbs. per acre.* | $\epsilon_d$ | $\frac{\overline{d}}{\epsilon_d}$. | *P.* |
|---|---|---|---|---|
| Black seeded ... ... | 1,150 | 1·01 | 5·6 | ·01 |
| Striped seeded... ... | 1,350 | | | |

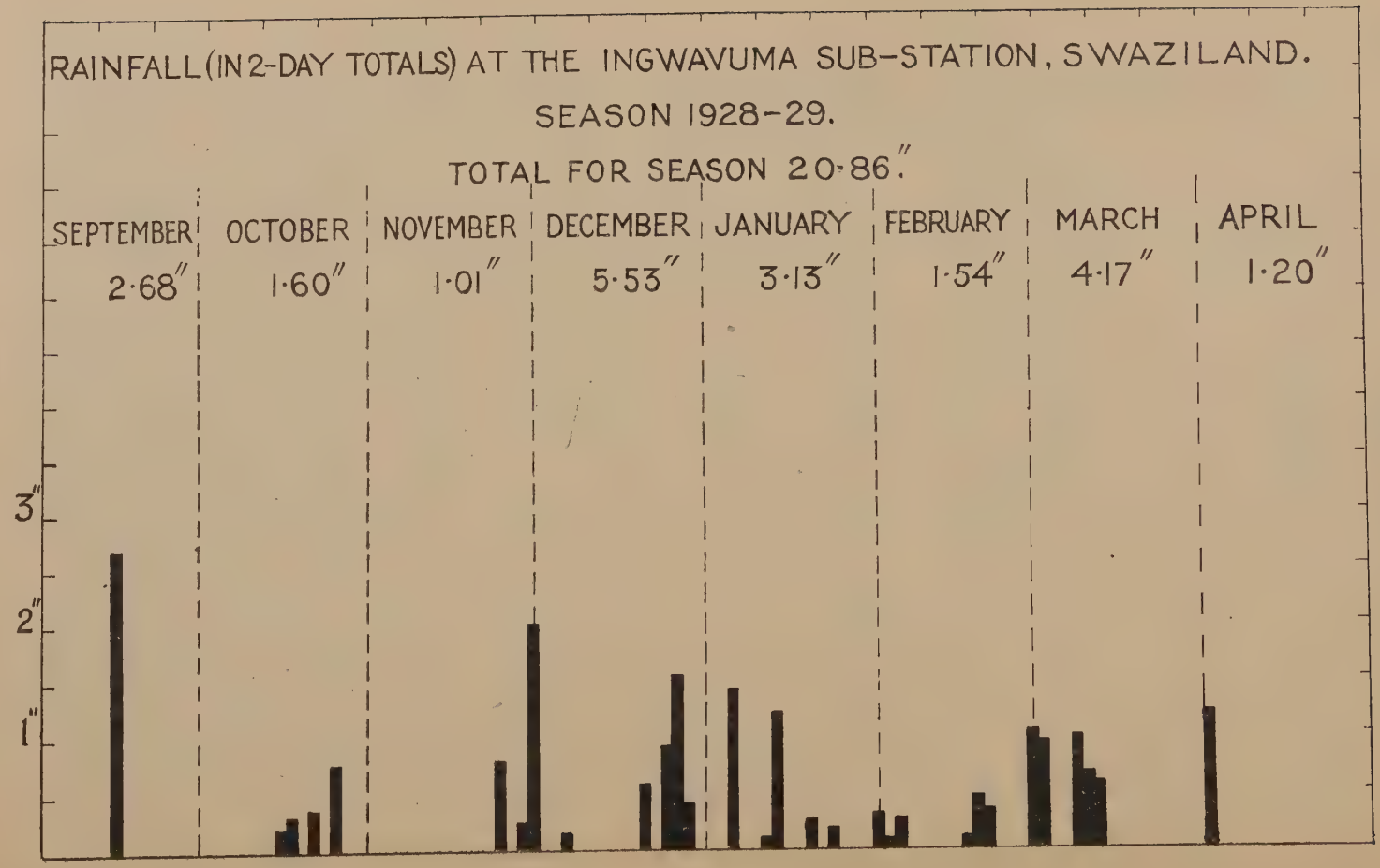
Plots of the sunflowers were sown in rows 2 ft. 6 ins. apart and in rows 3 ft. apart on the half-drill system for comparison of yields. There was no significant difference in yield, although a difference in the size of heads and weight of seeds produced was recorded, and this aspect of the response of the plants to different spacing treatments is of first importance.

*Soya Beans.*—Twelve varieties of these were grown in comparative plots. They experienced low moisture conditions during pod setting, and made inferior vegetative growth. The yields, however, were equal to those at Magut where the plants were regarded as having made excellent growth. Seven of the varieties gave yields of from 1,000–1,250 lbs. of beans per acre. There was no nodule formation. The relative merits of these varieties depend largely on the extent to which they shatter their seed. One, at least, a yellow-seeded variety known as Southern, appears to be comparatively non-shattering.

There has been some loss of flowers from the Cantharides beetle, but it does not appear to feed on the small sessile flowers of these beans to a large extent. Disease has so far been confined to a leaf spotting disease which does not appear to retard the plant's growth.

*Sorghums.*—The plots of sorghums were confined to a number of dwarf and semi-dwarf sorghums with short maturation periods. Some of these were selections which had been taken in the previous season. They gave much higher yields in observation rows only, and may be better than local material, given further selection. The number of sorghums for growth trials should be greatly increased from seed that is being received from various sources, and special attention is being paid to white seed forms as these are reported to find favour on overseas markets.

*Pests.*—Black cotton seedling beetles of the genus *Syagrus*, one of which, *Syagrus rugifrons*, has been referred to frequently in the Candover district, made their appearance here during the season, and dusting and trap measures should be carefully conducted to check the spread of this pest.


RAINFALL (IN 2-DAY TOTALS) AT THE INGWAVUMA SUB-STATION, SWAZILAND.
SEASON 1928-29.
TOTAL FOR SEASON 20·86″
SEPTEMBER 2·68″
OCTOBER 1·60″
NOVEMBER 1·01″
DECEMBER 5·53″
JANUARY 3·13″
FEBRUARY 1·54″
MARCH 4·17″
APRIL 1·20″
3″
2″
1″

# REPORT ON ENTOMOLOGICAL WORK ON COTTON CARRIED OUT ON THE PREMIER COTTON ESTATES OF SOUTH AFRICA LTD., SEASON 1928-1929

BY

C. B. R. KING.

This report covers the period from October, 1928, to March, 1929, which was spent at Moamba, near Lourenco Marques, on the estate of the Premier Cotton Estates of South Africa Ltd. The estate covers several thousand acres of very flat, cultivated land, and the object in going there from Nyasaland was to find out if the method of controlling the Sudan bollworm by means of light traps, initiated in Nyasaland on a small scale, would succeed over a large area.

The crops of the two previous years had not done well, owing partly to dry weather at planting time, and partly to bollworm attack, which developed about March and April. After about four months of dry weather, in 1928, about an inch of rain fell in the last week of October. This fall brought about an immense emergence of moths, in which the females were about ten times as numerous as the males at first, becoming more or less equal towards the end of November. The potential damage at this time would have been enormous, but some of the cotton had been removed, and more had been cut back for ratooning to different heights for experimental purposes. Even the shortest, at six inches, had eggs freely laid on it, though there was little food available for the larvæ. On the whole, therefore, this emergence did not do much damage, and nearly all the caterpillars must have died from starvation or some other cause. No emergence comparable with this one took place later, and no great mass attack on the 1929 cotton was made by Sudan Bollworm.

The acetylene lamps to be used were of two types—one a bucket lamp of 300 c.p. and four burners, the other a 1,000 c.p. flare. In operating these, trestle tables about three feet high were used ; a two feet square tin, five inches high, was placed on top, with about three inches of water in it. At night paraffin was poured on the water, and the light over the centre was lit. For the flares, larger pans were used, and the amount of paraffin was one to four pints, according to size. It was eventually found convenient to standardise one size of tin (two

feet square by five inches high), and where a powerful light was used four were placed together in a square. This arrangement, besides being more suitable mechanically, greatly facilitated the collection of insects.

The catches varied considerably with the weather, but on occasion were quite big. Thus, on the night of December 13–14, 1928, under a 1,000 c.p. flare, 146 males and 193 females were captured in a field of ratoons (400 acres), and on March 8–9, 1929, a 100 c.p. light caught 17 males and 14 females. It was found that the proportion in which males exceeded females increased considerably after the turn of the year. The figures from the traps, week by week, show the following proportions between the dates given.

In column I are the results from ratoon fields, while those in column II are calculated from captures in seedling cotton only.

Sudan Boilworm Moth, Percentage Catches.

| | I. | | II. | |
|---|---|---|---|---|
| *Week.* | *Males.* | *Females.* | *Males.* | *Females.* |
| 1928—Dec. 3– 9 ... ... | 53·5 | 46·5 | — | — |
| 10–16 ... ... | 43 | 57 | — | — |
| 17–23 ... ... | 34·5 | 65·5 | — | — |
| 24–30 ... ... | 53·4 | 46·6 | — | — |
| Dec. 31–Jan. 6... ... | 92·5 | 7·5 | — | — |
| 1929—Jan. 7–13 ... ... | 72·75 | 27·25 | 70·5 | 29·5 |
| 14–20 ... ... | 79·25 | 20·75 | 68·5 | 31·5 |
| 21–27 ... ... | 76·6 | 23·4 | 80 | 20 |
| 28–Feb. 3 ... | 86·5 | 13·5 | 45 | 55 |
| Feb. 4–10 ... ... | 96·5 | 3·5 | 90·5 | 9·5 |
| 11–17 ... ... | 87 | 13 | 74·5 | 25·5 |
| 18–24 ... ... | 91·7 | 8·3 | 84·5 | 15·5 |
| 25–Mar. 3 ... | 76·8 | 23·2 | 50 | 50 |
| Mar. 4–10 ... ... | 85·2 | 14·8 | 60 | 32 |
| 11–17 ... ... | 93·7 | 6·3 | 89 | 11 |

Although it is an undoubted fact that acetylene light attracts females, and nearly all those taken were fully gravid, it was felt that in the larger fields the lights were not exercising a control over the whole of them, and it was decided to try electric light. Further, a large number of acetylene lights employed over a big area involves a great deal of labour, and supervision is difficult, especially in regard to the lighting of the lamps. Eventually it was resolved to install a 9 kw. generator, which could be run from an existing engine of 15 h.p., and a single 500 watt lamp of the gas-filled type was first tried on the night of January 28–29, 1929, in a field of 120 acres of ratoon cotton. From the night of January 15–16 onwards, a 1,500 c.p. flare had been put in this field to give some indication of what was to be caught. The figures for male and female moths taken are as follows :—

| Date. | I. | | II. | |
|---|---|---|---|---|
| | *Males.* | *Females.* | *Males.* | *Females.* |
| 1929—Jan. 16 ... ... ... | 27 | 16 | 65 | 24 |
| 17 ... ... ... | 32 | 14 | 70 | 16 |
| 18 ... ... ... | 51 | 1 | 70 | 17 |
| 19 ... ... ... | 57 | 7 | 108 | 13 |
| 20 ... ... ... | 19 | 10 | 16 | 5 |
| 21 ... ... ... | 7 | 1 | 2 | 3 |
| 22 ... ... ... | 19 | 0 | 10 | 3 |
| 23 ... ... ... | 5 | 2 | 6 | 2 |
| 24 ... ... ... | 1 | 1 | 3 | 1 |
| 25 ... ... ... | 11 | 5 | 30 | 4 |
| 26 ... ... ... | 3 | 0 | 3 | 0 |
| 27 ... ... ... | 0 | 0 | 0 | 0 |
| 28 ... ... ... | No light durin | g change-over | 0 | 0 |
| 29 ... ... ... | 332 | 24 | 47 | 5 |
| 30 ... ... ... | 99 | 25 | 39 | 7 |
| 31 ... ... ... | 245 | 33 | 26 | 13 |
| Feb. 1 ... ... ... | 152 | 41 | 49 | 31 |
| 2 ... ... ... | 101 | 6 | 10 | 0 |
| 3 ... ... ... | 279 | 35 | 34 | 34 |
| 4 ... ... ... | 296 | 10 | 85 | 5 |
| 5 ... ... ... | 193 | 5 | 46 | 1 |
| 6 ... ... ... | Engine out | of order. | No light | —storm. |
| 7 ... ... ... | 185 | 3 | 5 | 0 |
| 8 ... ... ... | 314 | 7 | 86 | 4 |
| 9 ... ... ... | 180 | 5 | 59 | 1 |
| 10 ... ... ... | 156 | 12 | 40 | 4 |

Column I gives the catches in the field referred to, while Column II shows the numbers caught in two other fields of ratoons by acetylene lights. The catches opposite a date refer to the previous night. The weather from January 23–27 inclusive was very windy, chilly at night, with very little manifestation of insect life, except the night of 24–25, which was fine and still; this night was also full moon. The figures pretty well reflect the adverse conditions. The change in the number of insects caught by electric light was very marked. No similar change occurred in the other fields, as shown in column II; thus it would appear that the electric light attracts more strongly than acetylene. Tests of the range of attraction were to have been carried out to give some working basis for the future, but as I was going on leave at the end of March, this could not be done. However, from previous experiments with acetylene I judged about 20 c.p. were necessary per acre; for a 50-acre field, 1,000 c.p. would be required. I should estimate electric light to be about six times as effective as acetylene, so that 1,000 c.p. (500 watts) might do for 250–300 acres (always supposing the area is fairly square, with the light in the middle). However, the problem of range is probably complicated by the absorption of the light rays of shorter wave length. It is believed that it is the violet end of the spectrum which attracts most strongly and experiments carried

out in America* give some support to this. The oriental peach moth and the codling moth were the insects used. Under the laboratory conditions obtaining, the largest number of moths of both species and sexes would fly to the strongest light in an unequally lighted compartment. When given a choice of colours, varying from red to violet, the intensities being more or less equal, practically all moths went to blue and violet. Few or none were attracted by red, and orange and yellow also proved unattractive compared with blueish lights. Green light, possessing no blue rays, was also found to be unattractive. Violet light was preferred to blue and purple, while ultra violet light was found more attractive than violet. Where ultra violet light was compared with an artificial daylight lamp, 75% of oriental peach moths went to the ultra violet light. When a blue screen was used with the daylight lamp and a special ultra violet screen for the other, only 5% went to the daylight lamp. The response of both sexes to coloured lights appeared to be similar. In these experiments no comparison of an unscreened and untinted lamp with coloured lights was recorded. A daylight lamp has blue-tinted glass, which may be regarded as an ordinary lamp shining through a blue screen. An acetylene light has considerably less violet light in it than has electric light. This may account for the greater attractive power of the latter. It would be worth while to try results with a quartz mercury vapour lamp, which is abundant in ultra violet light; but whatever the absorption of light rays may be, for small areas such as those for which acetylene might be used, 20 c.p. per acre may be taken as a guide.

### Effect of Light on Other Insects.

*American Bollworm Moth.*—The number of this species captured in the traps was very low, and this applied both to acetylene and electric light, though the numbers caught by the electric light were greatly in excess of the others. Further observation on this point will be necessary to find out the effect of electric light in a place which has suffered badly the previous season before it could be recommended as a control, but its seasonal history shows that it is a pest which is liable to turn up suddenly in large numbers, and unless lights were in readiness (assuming them to be effective) the check would be of no value.

*Spiny Bollworm Moth.*—This moth appeared to be much more strongly attracted to electric light than to acetylene light. Although the latter totalled more than 6,000 c.p., the electric light (about 1,000 c.p.) attracted four times as many moths during 45 nights of working. This pest, however, is not regarded as a particularly serious one. The majority (95%) of females taken were gravid.

* Peterson & Haeussler, "Ann. of Ent. Soc. of Am.," XXI, No. 3, Sept., 1928.

*Stainers.*—On certain nights, stainers appeared to be quite strongly attracted. Comparatively big catches were confined to one place, where there was a large acetylene flare, and took place on nine different nights between December 16, 1928, and February 28, 1929. The average catch per night was 38 males and 28 females. Stainers in various stages were numerous in this field. Those found in the traps were always slim, although there were plenty of fat ones about. It seems possible that they are only susceptible to light after reaching maturity, but before they have taken any food. On many other nights and in all traps a few were caught, but light does not appear to be of any value as a check.

### The Relation of Atmospheric Conditions to Captures of Moths at Night.

The degree of humidity of the atmosphere appears to exercise a greater influence on activity than does temperature, within limits. In Nyasaland, this activity began at dusk every night, except when there was much wind, which was very rare. This corresponded with a rise of the humidity to its maximum at this time, which is almost invariable during the rainy season. The case is quite different in Moamba. On the majority of nights, humidity did not reach 80% till 9 or 10 o'clock at night, maximum being around 90%. On some nights it never reached this maximum at all, but other nights about 4–6 hours of maximum humidity was the rule, beginning from 10 to midnight. This delay in reaching the maximum appears to be caused, at any rate in part, by the direction of the wind. A north wind is dry, while a south wind brings rain. An east wind is also damp. A light breeze from the north appears to keep everything subdued, but as soon as it changes to south, which it frequently does within a very few minutes, flying insects become abundant. In these circumstances, insects are often not caught before 9 or 10 p.m. The following night chart shows the distribution of catches through the night of Sudan bollworm moths :—

Night of December 13–14, 1928.

| *Hour.* | *Males.* | *Females.* | *Remarks.* |
|---|---|---|---|
| 7–8 | — | — | Lamp lit at 7 p.m. |
| 8–9 | 12 | 36 | |
| 9–10 | 13 | 45 | |
| 10–11 | 21 | 50 | |
| 11–12 | 18 | 31 | |
| 12–1 a.m. | 19 | 10 | |
| 1–2 | 21 | 5 | |
| 2–3 | 27 | 10 | |
| 3–4.30 | 15 | 6 | Daylight about 4.30. |

This happened to be the largest catch with the strongest acetylene light. It shows, in the first place, the lack of anything before 8 p.m. (there were only six insects all told at 8 p.m.), and also the falling off in the females caught after the first two or three hours. This feature was shown on other observed nights—the males continue active all through.

As long as there is good humidity, there will be considerable activity on the part of insects, which at the same time can tolerate a wide range of temperature. The main factors which encourage this activity are humidity, warmth and stillness, while dryness and wind suppress it.

### Remarks on Technique.

*Traps.*—As mentioned before, insects attracted to the lights were imprisoned in a pan of water below, on to which was poured a little paraffin. This is a convenient substance for the subsequent analysis of the catch, but its drawback is that it has to be poured on every evening, as during the daytime, and especially under a hot sun, it evaporates too quickly. When analysis is not required, it might be worth trying soapy water. A liquid soap could be made up and added to the water, and this would last some time, needing only occasional renewal.

### Wild Host Plant of Sudan Bollworm.

The wild plant Cienfugosia, found by Parsons in Zululand to be a wild host plant of this bollworm, is very common on the uncultivated parts of the estate, and eggs and caterpillars were commonly found in it everywhere.

## ADDENDUM.

Since the foregoing was written, information has come to hand on experiments carried out in France by G. Gourdon (1) (2) on trapping insects with ultra-violet light. The source used is a mercury vapour lamp, which rests on an upright pillar through which air is drawn by an electric suction apparatus. Insects appear at first to experience a sensation of well-being, but quickly become dazzled and inert. The actual attraction is stated by the author to be due to ozone formed by the action of ultra-violet rays on the oxygen of the air, and when within range of the light the insects become paralysed.

All kinds of insects are attracted, diurnal as well as crepuscular and nocturnal, and the apparatus described and figured in the text of the papers is designed for use in vineyards.

(1) Le Progres Agric, et Vitic. Mar. 3, 1929, p. 204.
(2) Rev. Agric. Fr. June 1929, No. 6 bis p. 52.

# SWAZILAND

## REPORT ON THE WORK OF THE COTTON EXPERIMENT STATION, BREMERSDORP, FOR THE SEASON 1928-1929,

BY

D. MACDONALD.

SUMMARY.

The past season, despite a bad beginning, finished up as the best season experienced by Swaziland for the past five years. The greater part of the cotton area was under jassid-resistant strains; this enabled the crop to take full advantage of the good conditions prevailing from February onwards, and to set and mature a late crop.

The chief result obtained from the cotton experiments was the confirmation of the results obtained the previous season, demonstrating the complete superiority of the U.4. strain over all other types of cotton tried. Last season the strain was only grown on the Experiment Stations, but this season, when grown on a field scale, in different areas, under a wide range of conditions, it bore out the results obtained on the Experiment Stations.

The successful multiplication of this strain during the past year has enabled all applications for U.4. seed to be filled, and next season practically no other type of cotton will be planted.

Some of the selections made from U.4 bulk in the previous season have shown a marked advance on the parent strain in uniformity, yield per acre, ginning percentage, and lint length.

The late advent of planting rains has enabled some useful results to be obtained with rotation crops other than cotton: sunflower, two varieties of groundnuts, and two varieties of beans have given yields which make them remunerative crops despite the heavy cost of transport in Swaziland. In addition they have shown that they can be planted late in the season and still mature their crop.

## Introduction.

The cotton crop returns from the Bremersdorp ginnery for the season under review show a nett increase of 86% over those of the previous season in the amount of lint exported. As this ginnery receives practically all the cotton grown north of the Usutu River, the return may be taken as an accurate representation of the result of the season's crop in that area.

For the area south of the Usutu River no actual figures could be obtained, because the crop is ginned at various ginneries outside Swaziland, but judging from farmers' crop returns, and personal observation throughout the year, there has been a marked increase in the total production of cotton in that area also.

This increase in production is not due to increased acreage, because the absence of planting rains until the end of November, coupled with the limited amount of jassid-resistant seed available, prevented any such increase. The increase can be put down to three causes :—

(i) Good rains from the end of February until the end of April, followed by mild conditions in the early part of the winter. (ii) The fact that the variety of cotton grown was jassid-resistant, which enabled the crop to take full advantage of the late rains and set a late crop. (iii) Freedom from bollworm damage.

Reference was made in last season's Report to the multiplication of seed of the U.4 strain ; this has been carried out most successfully by the farmers who undertook the task, and will be dealt with in detail later.

## Station and Buildings.

As the area of land used during last season was found to be much too small for the requirements of the work, an area of 24 acres was rented from Mr. P. J. Lewis for use as a permanent Station. The new area is a medium red loam, fairly uniform throughout, and has the great advantage of being good, level land. It has been laid out in long narrow fields with a view to lessening the damage liable to be done by wash.

A wood and iron building 15 feet by 35 feet has been erected alongside the Station as a seed store, and a compound for housing the native labour employed has also been completed during the season.

## Season and Climatic Conditions.

The total rainfall for the season, 28.58 inches, recorded on the Station was ample for the requirements of the crop, but the distribution was very poor, the excessive rains in March causing a considerable

amount of shedding. The above figure was much higher than the average rainfall for the surrounding district, however, and cannot be taken as a rigid guide to the general conditions. A better indication of the general rainfall north of the Usutu is given by the records taken at Mr. G. L. Wallis's farm on the White Umbeluzi, where the total for the twelve months ending June 1929, was 20.84 inches.

Following three dry months, the first effective rain fell on the 15th–16th of September, and on this a start was made in preparing the land for planting. From this date until the 24th of November no rain of sufficient dimensions to warrant planting was recorded. The small areas planted on the September rain all perished and had to be replanted later. Thus the bulk of the crop was planted between the 24th of November and the middle of December, six weeks later than the normal planting period in this district.

In Southern Swaziland conditions were even more adverse, and in part of the Ingwavuma district little rain fell between September and the latter part of December, necessitating the replanting after Christmas of the land sown in September.

For the first two and a half months after planting, the rains were just sufficient to keep the crop going, and it was not until the February–March rains that any reserve of sub-soil moisture was established. From then onwards conditions were exceptionally good, and were reflected in the heavy late pickings obtained.

### Variety Trial.

In the eight-strain variety test carried out last season, the results showed three strains viz., U.4, A.12, and Z.1–9, to be decidedly superior to the local cotton, Uganda, and also to the other strains included in the test. With a view to obtaining further information as to their comparative value, the three strains U.4, A.12, and Z.1–9, were again included in a test along with the local Uganda variety as a jassid control.

The trial was of the half-drill strip form. Variety A.12 was used as control to U.4, to A.12, to Z.1-9, and to Uganda, and there were eight repetitions of each of these three varieties. Thus sixteen comparisons were available between a variety and the control.

The experiment was planted on November 27th under favourable germination conditions and a uniformly good stand was obtained throughout. No great differences were exhibited by the strains until

the end of December, when a very severe attack of aphis set in. A.12 suffered appreciably more than any of the other varieties, and took much longer to recover. Both U.4 and Z.1–9 recovered quickly and put on considerable fresh growth before A.12 showed any signs of recovery.

The heavy February rains produced vegetative growth, but while U.4 and A.12 at the same time set a good crop, the Z. variety went entirely to wood, and any fruit set was shed immediately. The heavy March rains, coupled with dull, sunless conditions, caused shedding among all the varieties. The effect was much more noticable on the Z.1–9 than on the other strains, on account of the fruiting habit of this strain, which produces a comparatively small number of large bolls, as compared with the prolific fruiting of U.4 bearing a large number of small bolls. In addition, U.4 holds on to the bolls already set much better than Z.1–9 does under adverse conditions.

Picking was begun on June 3rd, and continued at intervals of fourteen days, the yields from each row being picked and weighed separately. The separate picking yields together with the total yields of seed cotton per acre for each variety are shown in Table I :—

TABLE I.

| *Variety.* | *1st Picking lbs. seed cotton per acre.* | *2nd Picking lbs. seed cotton per acre.* | *3rd Picking lbs. seed cotton per acre.* | *4th Picking lbs. seed cotton per acre.* | *Total lbs. seed cotton per acre* |
|---|---|---|---|---|---|
| U.4 ... | 214·25 | 336·0 | 436·2 | 239·2 | 1225·6 |
| A.12 ... | 132·5 | 203·3 | 301·6 | 216·0 | 853·4 |
| Z.1–9 ... | 145·6 | 126·4 | 185·3 | 108·0 | 565·3 |
| Uganda ... | 155·0 | 143·4 | 122·6 | 46·0 | 467·0 |

Examination of the figures shows that the results obtained are similar to those of previous season, and the varieties follow the same order of merit. U.4 has again convincingly demonstrated its superiority in every respect over all the others, with A.12 a good second. The difference between A.12 and Z.1–9 in the final yield figures is more pronounced than in the previous season on account of the shedding already referred to. Jassid was again the limiting factor in the yield obtained from the local variety, Uganda.

The results of the examination of the yields of the two row totals of each variety, compared with the yields of the adjacent two rows of the standard A.12, are summarized in Table II. U.4 shows a significant increase, while the yields of both Z.1–9 and Uganda are significantly lower than that of the standard A.12 :—

TABLE II.

| *Variety.* | *Yield per acre. lbs. of seed cotton.* | *Mean Yield per Half Strip. lbs. of seed cotton.* | *D = Mean Difference from Standard A.12 (ozs).* | *E = Standard Error of Mean Difference.* | *Ratio* $D/E$ |
|---|---|---|---|---|---|
| U.4 ... | 1225 | 283·7 | +84·5 | 6·00 | 14·08 |
| A.12 ... | 853·3 | 197·1 | — | — | — |
| Z.1–9 ... | 565·3 | 130·3 | −67·3 | 7·66 | 8·78 |
| Uganda ... | 466·0 | 107·7 | −78·6 | 6·22 | 12·60 |

The lint characters and boll weights of the varieties tested are given in Table III:—

TABLE III.

| *Variety.* | *Boll Wt. (gms.).* | *Lint Length (mms.).* | *Weight of 100 Seeds (gms.).* | *Ginning %* |
|---|---|---|---|---|
| U.4 ... ... ... | 5·2 | 30·3 | 9·9 | 33·8 |
| A.12 ... ... ... | 6·2 | 27·8 | 11·6 | 32·3 |
| Z.1–9 ... ... | 6·5 | 29·5 | 12·5 | 30·2 |
| Uganda ... ... | 5·0 | 28·0 | 10·8 | 30·7 |

Spacing Tests.

U.4 The spacings tried were 1 foot 18 inches and 2 feet in the row, the plots used being twelve-row plots, with rows 90 feet long, and 3 feet 6 inches apart. The spacings were randomized in four blocks giving four repetitions for each spacing. In taking yield figures, single row yields were taken from the eight centre rows of each plot, cutting out two rows on each side of the plot to eliminate the effect of one spacing on the adjacent plot with a different spacing.

The whole experiment was planted out through a planter on December 4th, and the plots thinned out to the different spacings when the plants averaged six inches in height. The yield figures show that the closer spacings gave the best result under the condition of late planting. The closer spacing also produced a better type of plant and had the effect of stimulating earlier setting of fruit. In any spacing test, the retaining of an approximately perfect stand throughout the season until the crop is picked is practically impossible, and this is all in favour of the closer spacings. Whereas a 5% loss of stand in a one-foot spacing may not lower the final yield very much, the same loss in a plot with a two-feet spacing will certainly have a serious effect on the final figures.

A.12—A similar experiment, using the same spacings with the variety A.12, was planted at a later date. Aphis attacked this experiment very severely during December and January, and it was not until

the middle of February that any proper growth was made. This, coupled with the fact that A.12 is a slowly maturing cotton, reduced the yields considerably.

The results for both varieties follow each other closely and are given in Tables IV and V:—

TABLE IV.

U.4—Yields of Seed Cotton.

| *Spacing.* | 1st *Picking lbs. per acre.* | 2nd *Picking lbs. per acre.* | 3rd *Picking lbs. per acre.* | 4th *Picking lbs. per acre.* | *Total lbs. per acre.* |
|---|---|---|---|---|---|
| 1 foot ... | 259·8 | 282·3 | 362·8 | 182·8 | 1,087·7 |
| 1½ feet ... | 240·6 | 219·0 | 315·7 | 173·5 | 948·8 |
| 2 feet ... | 196·8 | 204·2 | 315·2 | 192·5 | 908·7 |

TABLE V.

A.12—Yields of Seed Cotton.

| *Spacing.* | 1st *Picking (lbs. per acre).* | 2nd *Picking (lbs. per acre).* | 3rd *Picking (lbs. per acre).* | *Total (lbs. per acre).* |
|---|---|---|---|---|
| 1 foot ... ... | 248·0 | 239·0 | 96·9 | 583·9 |
| 1½ feet ... ... | 212·4 | 255·7 | 114·2 | 582·3 |
| 2 feet ... ... | 176·1 | 215·8 | 102·9 | 494·8 |

## Selections.

Small amounts of seed of 126 single plant selections of U.4 made at the Barberton Station in the previous season were obtained and planted out in two-row plots for observation purposes with a view to further re-selection. Although late planted, good growth was made in the early part of the season and all ripened their crop.

A severe attack of jassid in the later part of the season eliminated about 10% of the total as not showing a sufficiently high degree of resistance to the pest. Finally seven lots out of the 126, judged on field observation and examination of lint characters, were retained for further trial. After the first picking three other lots were added to these at Mr. Parnell's request, on account of their behaviour at the Barberton Station. Although only a small number of the best were retained, the general level of the whole of the original selections is shown in the average yield for the whole block, which amounted to 973 lbs. seed cotton per acre.

The selected lots were picked separately, and their yield figures, lint characters, etc., are given in Tables VI and VII. The above ten selections will be put out in a variety test during the coming season, and in addition small observation plots of them will be planted in as many different areas as the amount of seed available permits.

TABLE VI.

SINGLE PLANT SELECTIONS.

| No. | Number of Plants. | 1st Pick. | 2nd Pick. | 3rd Pick. | 4th Pick. | Total Yield. | Yield in lbs. per acre. | Percentage Stand. |
|---|---|---|---|---|---|---|---|---|
| | | lbs. oz. | lbs. oz. | lbs. oz. | lbs. oz. | lbs. oz. | | |
| C.15 ... | 85 | 4 9 | 4 2 | 7 9 | 2 14 | 19 2 | 1339 | 92 |
| C.39 ... | 56 | 1 9 | 2 5 | 6 1 | 2 14 | 12 13 | 897 | 61 |
| L.18 ... | 53 | 4 2 | 4 3 | 6 6 | 3 1 | 17 12 | 1248 | 58 |
| H.7 ... | 76 | 4 7 | 4 4 | 6 6 | – – | 15 1 | 1054 | 83 |
| H.11 ... | 73 | 4 7 | 5 3 | 4 12 | – – | 14 6 | 1005 | 79 |
| H.41 ... | 84 | 3 6 | 3 11 | 7 4 | – – | 14 5 | 1002 | 91 |
| H.67 ... | 81 | 3 6 | 4 0 | 5 9 | – – | 12 15 | 862 | 88 |
| H.77 ... | 77 | – – | 4 8 | 4 6 | – – | 8 14 | — | — |
| Z.9 ... | 82 | – – | 3 11 | 7 10 | – – | 11 5 | — | — |
| Z.14 ... | 87 | – – | 5 1 | 10 8 | – – | 15 9 | — | — |

TABLE VII.

SINGLE PLANT SELECTIONS.

| No. | Boll Wt. (gms.). | Lint Length (mms.). | Wt. of 100 seeds in gms. | Ginning %. |
|---|---|---|---|---|
| C.15 ... ... ... | 5·2 | 32·8 | 9·4 | 37·5 |
| C.39 ... ... ... | 4·6 | 32·9 | 9·9 | 35·2 |
| L.18 ... ... ... | 5·2 | 34·0 | 10·8 | 34·7 |
| H.7 ... ... ... | 5·1 | 32·6 | 11·2 | 37·2 |
| H.11 ... ... ... | 5·1 | 32·1 | 11·1 | 36·0 |
| H.41 ... ... ... | 4·5 | 32·5 | 10·8 | 34·1 |
| H.67 ... ... ... | 4·7 | 32·4 | 11·5 | 34·0 |
| H.77 ... ... ... | 5·1 | 33·2 | 9·4 | 36·3 |
| Z.9 ... ... ... | 4·9 | 31·9 | 9·2 | 38·2 |
| Z.14 ... ... ... | 4·6 | 32·8 | 9·1 | 36·1 |

In addition to the above selections, five small bulk selections U.4/2 ; U.4/3 ; U.4/4 ; U.4/5 and U.4/6 were put out in quarter-acre blocks for observation. Of these U.4/2 is a tall vigorous type, rather mixed as regards fruiting but containing some very good plants. U.4/6 is a somewhat similar but slightly more vegetative type. U.4/3 turned out the worst of the lot, a coarse poor fruiting type, and has been discarded as being inferior to bulk U.4. U.4/5 and U.4/4 are both alike in being a much smaller type than any of the others. U.4/5 is a small free-fruiting plant bearing a very small boll, but producing good length lint, having a high ginning percentage. U.4/4 was easily superior to the others in every respect, including yield, lint length and ginning percentage. In addition, it was the earliest of the five lots and is also much more uniform in habit of growth.

Special bulks have been taken from U.4/2, U.4/4, U.4/5 and U.4/6, and this seed will be further tested during the coming season in a variety trial against U.4 bulk. Arrangements have also been made with

farmers in different areas to plant small observation plots of the above four lots in order to obtain further information as regards their respective merits and behaviour under diverse conditions.

The yields per acre and analysis of the lint characters of the four lots are shown in Table VIII :—

TABLE VIII.

| *Variety.* | *Yield, lbs. seed cotton per acre.* | *Boll Wt. (gms.).* | *Lint Length (mms.).* | *Wt. of 100 seeds gms.* | *Ginning %* |
|---|---|---|---|---|---|
| U.4/2 ... | 989·5 | 5·2 | 32·1 | 10·6 | 33.6 |
| U.4/4 ... | 1,097·0 | 5·1 | 33·9 | 10·9 | 36·8 |
| U.4/5 ... | 924·9 | 4·6 | 32·0 | 10·0 | 35·0 |
| U.4/6 ... | 925·0 | 4·9 | 31·4 | 10·9 | 35·2 |

### Seed Multiplication and Distribution.

Just under 1,100 lbs. of U.4 seed were available for multiplication in Swaziland at the beginning of season 1928–1929, and this has resulted in the production of 38 tons of seed for general distribution this coming season. The seed was allocated in small lots of 15 lbs. and upwards for planting at the rate of 5 to 7 lbs. per acre, and despite thin stands and adverse conditions some record yields were obtained. The lowest yields amounted to over 500 lbs. seed cotton per acre, while the highest yield was obtained by Mr. G. L. Wallis, who returned a yield of 1,641 lbs. seed cotton per acre, from a 15 acre block.

The seed was multiplied in places which permitted of observing the behaviour of this strain, under widely divergent conditions of soil and climate, and in all cases the results exceeded expectations. Possibly the most remarkable demonstration of the cropping possibilities of this strain under really bad conditions was afforded by a 39-acre block on land belonging to the Swaziland Corporation Plantations Ltd. The land used was a very thin sandy soil and the 39 acres were hand planted with 250 lbs. seed. This block returned an average yield of 813 lbs. seed cotton per acre, on a total rainfall for the year of 14.27 inches. Of this total over 2 inches fell in the beginning of September, and as the crop was not planted until the end of November, the above yield was really obtained on a total rainfall of 12 inches.

The yield of 1,641 lbs. per acre returned by Mr. G. L. Wallis was obtained under rather better conditions. The land used was a deep river silt soil which received a dressing of 3 tons kraal manure and 175 lbs. superphosphate per acre before planting. The crop was planted immediately after ploughing the land on 27th–28th November, and matured in two pickings, the last taking place on the 19th June.

The total cost of production of the crop, including the transport of the seed cotton to the ginnery, but excluding rent on land and depreciation on implements used, amounted to 0·483d. per lb. of seed cotton. The rainfall figures of the records taken at Mr. Wallis's farm are shown at the end of the Report.

The seed returned by the different multipliers who forwarded their cotton to the Bremersdorp Ginnery are given in Table IX :—

TABLE IX.

| *Plot.* | *Seed issued. lbs.* | *Area planted. acres.* | *Yield per acre. lbs. of seed cotton.* | *Ginning %* |
|---|---|---|---|---|
| 1 ... ... ... | 250 | 39 | 813 | 34·0 |
| 2 ... ... ... | 110 | 15 | 1,641 | 33·0 |
| 3 ... ... ... | 15 | 2 | 1,200 | 33 |
| 4 ... ... ... | 125 | 24 | 1,009 | 34·12 |
| 5 ... ... ... | 40 | 7 | 1,407 | 34·26 |

The ginning figures are the figures of the commercial ginnery.

The distribution of the multiplication areas throughout the territory has enabled the majority of growers to see this strain growing in their own area, and the enthusiasm it has caused among them is reflected in the applications for seed for the coming season. The seed supply of this strain produced in Swaziland has had to be augmented by the purchase of the surplus seed from the Barberton district to meet the requirements of the growers. By this means all applications for U.4 seed have been filled, and next season practically no other variety of cotton will be grown in Swaziland.

In addition to the high average yields per acre obtained, the high ginning percentage of this strain of cotton shows a big advance over the ginning percentage of the old cottons which seldom exceeded 30%.

No further multiplication of seed will be done this season, but a number of re-selections from U.4 will be planted in widely scattered areas in Swaziland in order to select the best for multiplication in the following season.

The thanks of the Corporation are due to the farmers who, by their energy and care of the multiplication areas, ensured that an ample supply of seed would be available for the general farming community this season. I am also glad of this opportunity to record my appreciation of the assistance given by the staff of the Bremersdorp Ginnery in connection with the general distribution of the seed multiplied during the past two seasons.

### Cambodia Selections.

Five small bulk selections from Cambodia, made by Parsons at the Magut Station, were tried on the Bremersdorp Station, but all proved unsuitable to local conditions. All developed into very big plants, and although they set a fair amount of fruit, did so much too late for a district which requires a quickly maturing type of cotton. Furthermore the large plants produced were unable to withstand the high winds common to this area, and most of the lateral branches were broken down before the end of the season.

### Rotation Crops.

A range of possible rotation crops was planted as in the previous season.

*Sorgums.*—Four varieties of the Indian Sorgums received from Barberton last season were planted out in observation plots, but for the second year in succession they failed to produce a crop. Growth during the early part of the season was very vigorous, but a severe attack of aphis followed by rust completely destroyed the whole series. Quite apart from this, the varieties tried appear to be much too slowly maturing type for this locality.

*Groundnuts.*—A wide range of groundnuts, including both erect or "bunch", and spreading types were grown. All were planted during the last week in December and experienced good growing conditions throughout the season. Two varieties were outstanding both as regards general behaviour and final yield. They were both bunch types, namely Small Japanese and Spanish No. 10, which gave yields of 1,484 lbs, and 1,429 lbs. respectively of unshelled nuts per acre. In addition to giving the heaviest yields, they matured more rapidly than any of the others and were reaped in the beginning of May. The local variety, Virginia Bunch, grown alongside them under the same conditions, and planted at the same time, yielded only 738 lbs. per acre.

Some of the spreading types gave yields of over 1,000 lbs. unshelled nuts per acre, but they mature very slowly under local conditions and are very expensive to reap. The red soil of the Station tends to bind, and it was found impossible to pull by hand any of the spreading varieties when reaping. The high transport rates within the territory make it essential that any crop which does not command a very high export price should be capable of being produced at a low cost. The reaping costs of the spreading varieties appear to rule out this type for the present, but the bunch varieties referred to are very promising.

*Beans.*—Three varieties of *Soy Beans* were grown and for the second year in succession the Yellow variety gave by far the best results. This variety gave an average of 1,041 lbs. per acre from four different plots, as compared with just over 600 lbs. per acre for the others.

One of the greatest drawbacks of the Soy Bean is that most of the varieties shatter very readily when ripe, and by the time the later formed pods are ripe the early set pods have shattered. All the varieties grown were left until over ripe in order to find out if there were any which did not shatter. All varieties except Yellow shattered very readily, but ten days after the Yellow was ready for reaping hardly a pod had shattered.

*Tepary Beans*, which have given such good results at the Barberton and Magut Stations, were again tried, but the yield obtained was not very high. Possibly earlier planting would have given better results, and this will be tried this season on other farms in the neighbourhood.

*Speckled Sugar Beans*, although they did not give a very high yield per acre, are a very remunerative crop on account of the high price they command on the Johannesburg market at certain months of the year. The prevalence of the Cantharides Beetle prevents the planting of them until late in the season, and the beans when reaped have to be stored in tanks until the market price in favourable. They also have to be watched carefully at reaping time as they shatter readily.

*Black Sunflower* was the most successful crop grown on the Station during the past season and yielded at the rate of 2,385 lbs. per acre, on a plot of slightly over a quarter of an acre. It has the advantage of being a quickly maturing crop, which can be planted much later than maize or cotton with every prospect of success. The above crop was planted on 27th December and reaped on the 11th May. The spacing used, 3 feet between the rows, and 1 foot in the rows appeared to be rather close under the conditions of ample moisture. In addition to being an easy crop to reap, it is easy to grow, requiring little attention, and its rapid growth enables it to keep down weed growth. It is remarkably free from disease and insect attack, and although the moisture conditions on the Station during its growth were ample, observations on crops grown on the low veldt show that it has excellent drought-resisting qualities.

The seed commands a ready export market, and although the price is not very high, the yields that can be obtained make it a very paying crop.

*Green Manures.—Sunnhemp* grew well, and when left for seed gave over 600 lbs. per acre. It is excellent as a green manure and seed has been distributed to farmers for that purpose.

*Buckwheat* also proved very suitable and yielded a heavy crop of green matter in a very short time.

Recapitulating, the rotation crops tried that appear to offer most prospect of success are :—

Groundnuts, Small Japanese and Spanish No. 10.
Sunflower.
Beans, Yellow Soy and Speckled Sugar.

All of these, in addition to being very remunerative crops, have the merit of being quickly maturing and can be planted with every prospect of success late in the season. This quality is most useful in a season like the past one, when the late rains delayed the planting of the major crops like cotton and maize. With the exception of Sunflower, all are soil improvers. In a season of early rains a land can be green manured and the green crop ploughed under in ample time to permit of any of the above crops being planted with a good chance of success.

## Insect Notes.

*Bollworm.*—The damage done by bollworm throughout Swaziland during the past season was comparatively slight. As in the previous season, the severe attacks were confined to individual farms, most of the damage being done by American Bollworm (*Chloridea obsoleta*). The most severe attack was on a field of cotton alongside the Station, where American Bollworm was first noticed towards the end of December, and remained throughout the season until the beginning of April. In March Red Bollworm appeared in the same field, while later in the season a small number of Spiny Bollworm moths were caught.

Three acetylene flares were obtained and used as light traps on this field, but although all three species of bollworm moths were freely caught, the three lights were not sufficient to control the attack on the forty-acre field. The lamps used were of the bucket type, fitted with a double jet burner, giving a naked flare of approximately 100 candle power. This strength of light was found insufficient to attract moths in bright moonlight nights, or to remain alight in wind. It is granted that moth activity may be limited while a strong wind is blowing, but quite frequently a gust of wind on an otherwise calm night was sufficient to extinguish the light.

Trap crops of ratoon cotton were again used, the cotton being grazed back by cattle in the early part of the season. Numbers of bollworm eggs and larvæ were destroyed in the traps in November and December, but the freedom from bollworm later in the season can not be wholly accounted for by the trap crops, as in some cases areas without trap crops suffered less than areas where trappings was carried out.

*Jassid.*—The effect of this pest was very noticable on the plots of Uganda cotton on the Station from February onwards. The severity of the attack increased as the season advanced, and proved very useful in thoroughly testing the jassid resistance of the new selections grown on the Station.

DAILY RAINFALL SEASON 1928–29.

MR. G. L. WALLIS'S FARM, WHITE UMBELUZI DISTRICT.

| | *Sept.* | *Oct.* | *Nov.* | *Dec.* | *Jan.* | *Feb.* | *Mar.* | *Apr.* | *May.* | *June.* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | — | — | — | — | — | 1·10 | 0·17 | 0·77 | — | — |
| 2 | 0·02 | — | — | — | — | 0·23 | — | 0·40 | — | — |
| 3 | — | — | — | — | — | — | 0·70 | — | — | — |
| 4 | — | 0·08 | — | — | — | — | — | — | 0·02 | — |
| 5 | — | — | — | 0·62 | 0·04 | 0·37 | — | — | — | 0·08 |
| 6 | 0·03 | — | — | — | — | — | — | — | — | — |
| 7 | — | — | — | — | — | — | 0·08 | — | — | — |
| 8 | — | — | 0·06 | 0·27 | — | — | 0·25 | — | — | — |
| 9 | — | — | 0·16 | — | — | — | 0·90 | — | — | — |
| 10 | — | — | — | 0·11 | 0·18 | — | 0·08 | — | — | — |
| 11 | — | — | 0·06 | — | — | — | 0·04 | — | — | — |
| 12 | — | — | — | — | 0·98 | — | — | — | — | — |
| 13 | — | — | — | — | 0·16 | — | — | — | — | — |
| 14 | — | — | — | — | 0·04 | — | — | 0·05 | — | 0·02 |
| 15 | 1·10 | — | — | — | — | — | — | — | — | 0·04 |
| 16 | 0·32 | — | — | — | — | — | — | — | — | 0·04 |
| 17 | — | 0·14 | — | — | — | 0·83 | 0·17 | — | — | — |
| 18 | — | 0·17 | — | — | — | 0·13 | 0·08 | — | — | — |
| 19 | — | — | — | — | 1·14 | 0·22 | 0·10 | — | — | — |
| 20 | — | — | — | — | — | 0·04 | — | — | — | — |
| 21 | — | — | — | — | — | — | 0·74 | — | — | — |
| 22 | — | 0·43 | — | 0·28 | 0·52 | 0·14 | 0·60 | — | — | 0·11 |
| 23 | 0·03 | — | — | 0·27 | — | — | — | — | — | — |
| 24 | — | — | 0·21 | 0·56 | — | — | — | — | — | — |
| 25 | — | — | 0·86 | — | — | — | — | — | — | — |
| 26 | — | — | 0·20 | 1·17 | 0·02 | — | — | — | — | — |
| 27 | — | — | 0·12 | — | — | — | 0·25 | — | — | — |
| 28 | — | — | 0·37 | 0·36 | — | 0·01 | 0·18 | — | — | — |
| 29 | — | — | 0·24 | — | — | — | — | — | — | — |
| 30 | — | — | — | — | — | — | — | — | — | — |
| 31 | — | — | — | — | 0·06 | — | 0·11 | — | — | — |
| | 1·50 | 0·82 | 2·28 | 3·64 | 3·14 | 3·07 | 4·45 | 1·22 | 0·02 | 0·29 |

Total for year (including 0·41 in August) 20·84 inches.

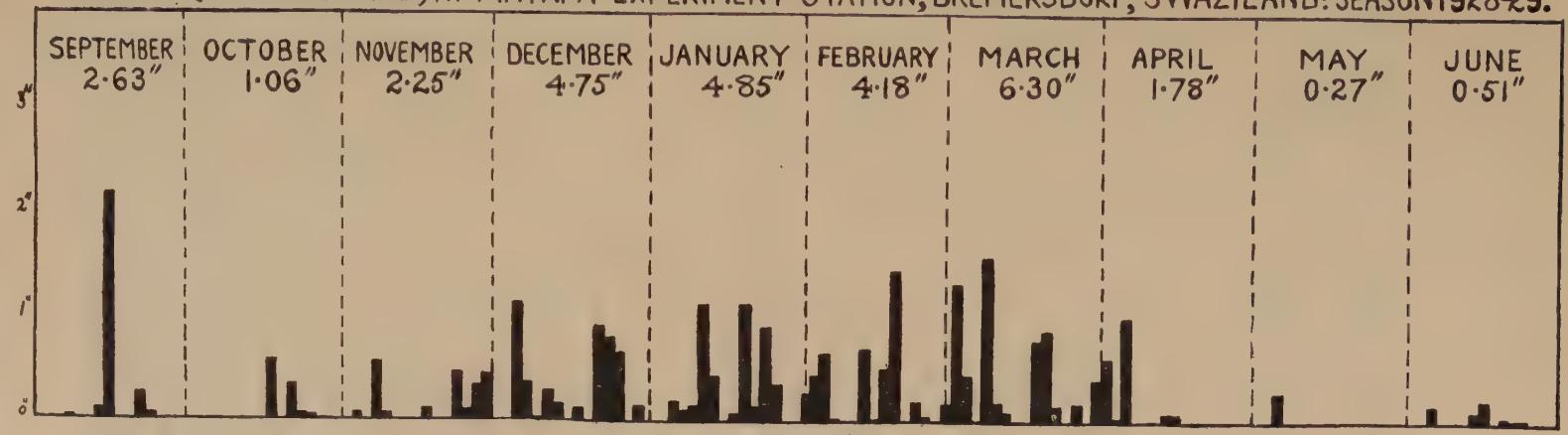
## DAILY RAINFALL SEASON 1928–29.

EXPERIMENT STATION, MATAPA, BREMERSDORP, SWAZILAND.

| | *Sept.* | *Oct.* | *Nov.* | *Dec.* | *Jan.* | *Feb.* | *Mar.* | *Apr.* | *May.* | *June.* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 ... ... | — | — | — | — | — | 0·09 | 0·18 | 0·54 | — | — |
| 2 ... ... | — | — | — | — | — | 0·45 | 0·07 | 0·08 | — | — |
| 3 ... ... | — | — | — | — | — | — | 1·28 | 0·02 | — | — |
| 4 ... ... | — | — | 0·07 | — | — | — | 0·16 | — | — | — |
| 5 ... ... | — | — | — | 1·16 | — | 0·67 | 0·30 | — | 0·27 | 0·10 |
| 6 ... ... | — | — | — | — | 0·19 | 0·01 | — | 1·01 | — | 0·05 |
| 7 ... ... | 0·02 | — | 0·15 | — | — | — | — | — | — | — |
| 8 ... ... | — | — | 0·43 | 0·39 | 0·10 | — | 0·87 | — | — | — |
| 9 ... ... | — | — | 0·07 | 0·02 | — | — | 0·75 | — | — | — |
| 10 ... ... | — | — | — | — | 0·15 | — | 0·10 | — | — | — |
| 11 ... ... | — | — | — | 0·30 | — | — | 0·08 | — | — | — |
| 12 ... ... | — | — | — | — | 1·13 | — | 0·09 | — | — | — |
| 13 ... ... | — | — | — | 0·11 | 0·44 | 0·71 | — | — | — | — |
| 14 ... ... | 0·10 | — | — | 0·07 | — | 0·01 | — | 0·07 | — | 0·10 |
| 15 ... ... | 1·54 | — | — | — | — | — | — | 0·06 | — | — |
| 16 ... ... | 0·67 | — | — | — | — | — | — | — | — | 0·21 |
| 17 ... ... | — | 0·30 | — | 0·12 | 0·07 | 0·52 | — | — | — | — |
| 18 ... ... | — | 0·30 | 0·11 | — | — | 0·54 | 0·15 | — | — | — |
| 19 ... ... | — | — | — | — | 1·00 | 0·95 | 0·65 | — | — | 0·03 |
| 20 ... ... | — | — | — | — | 0·14 | — | — | — | — | — |
| 21 ... ... | — | — | — | — | — | — | 0·89 | — | — | — |
| 22 ... ... | 0·26 | 0·35 | — | 0·93 | 0·15 | 0·16 | 0·15 | — | — | 0·01 |
| 23 ... ... | 0·04 | — | — | 0·43 | 0·92 | 0·04 | — | — | — | 0·01 |
| 24 ... ... | — | 0·07 | 0·48 | 0·39 | — | — | — | — | — | — |
| 25 ... ... | — | 0·04 | — | — | 0·27 | 0·03 | — | — | — | — |
| 26 ... ... | — | — | 0·11 | 0·68 | 0·10 | — | — | — | — | — |
| 27 ... ... | — | — | 0·19 | — | — | — | 0·17 | — | — | — |
| 28 ... ... | — | — | 0·17 | — | — | — | — | — | — | — |
| 29 ... ... | — | — | 0·35 | — | — | — | — | — | — | — |
| 30 ... ... | — | — | 0·12 | 0·15 | — | — | — | — | — | — |
| 31 ... ... | — | — | — | — | 0·19 | — | 0·41 | — | — | — |
| | 2·63 | 1·06 | 2·25 | 4·75 | 4·85 | 4·18 | 6·30 | 1·78 | 0·27 | 0·51 |

Total for year 28·58 inches.

RAINFALL (IN TWO-DAY TOTALS) AT MATAPA EXPERIMENT STATION, BREMERSDORP, SWAZILAND: SEASON 1928-29.




TOTAL 28·58″.

# SOUTHERN RHODESIA

## REPORT ON THE WORK OF THE COTTON-BREEDING STATION, GATOOMA, FOR THE SEASON 1928-29.

INTRODUCTORY NOTE BY THE HON. R. A. FLETCHER, M.L.A.,
*Minister of Agriculture and Lands.*

THERE are few Votes on our Annual Estimates of Expenditure that afford me more satisfaction in approving than that which provides for the Plant-Breeding Station and Cotton Seed Farm at Gatooma, where Major Cameron and his staff of keen and industrious officers are carrying on such useful work in the interests of our Agricultural Industry.

Rhodesia, being a young country, is ever on the look out for fresh avenues for agricultural development, and in the past has at times, I am afraid, embarked on new crop-growing ventures with more enthusiasm and enterprise than perhaps prudence would have dictated. The cotton-growing boom was one of these occasions, and the crop might well have been permanently turned down in the reactionary spirit of disappointment which followed, but for the good services of the Empire Cotton Growing Corporation. Unobtrusively and methodically have the plant-breeding experiments been carried on from season to season at the Gatooma Station, while interest in cotton as a crop has been kept alive by co-operation with a few progressive growers until ultimately suitable resistant strains have been evolved and seed production developed. Major Cameron, always hopeful and encouraging, is now sounding a more optimistic note. He believes that he and his staff have achieved a measure of success and that the industry is on the eve of being launched on a commercial scale. This is very welcome news, and nowhere more welcome than with the Government. It comes at a most opportune time. Not only do we now see hope in cotton as a much-needed rotation crop in the economic scheme of many of our farms, but there are possibilities of it taking its place as the most marketable " money crop " that can be developed on others.

I am glad to be able, on behalf of the Government, to associate myself with this work, and would like to congratulate Major Cameron and his associates on the progress that has been made. Complete and unqualified success is a reward which seldom if ever comes in our human struggles, but genuine purposeful work has always its own great value on the credit side of any honest endeavour.

NOTE BY G. S. CAMERON.

The following report by Mr. Peat of the work done at the Cotton-Breeding Station, Gatooma, during the past year, requires little, if any, amplification by the writer or anyone else for that matter. At the same time it has afforded an opportunity to the Hon. R. A. Fletcher, M.L.A., Minister of Agriculture and Lands, of associating himself on behalf of the Government of Southern Rhodesia with the work of re-establishing the cotton-growing industry, this time, it is hoped, on a surer foundation than in the past.

About a year ago, when it was decided to proceed with the bulking up of U.4 cotton-seed, the writer fervently hoped for an unfavourable season in order to try out the new cotton to its utmost. That his hopes have been fully realised in this direction is amply borne out by a perusal of Mr. Peat's Report, which clearly indicates the unsatisfactory nature of the season which U.4 cotton has weathered. Had it been otherwise, we could not look forward to the future with the same degree of optimism as we do to-day. In a really favourable season we should be justified in expecting returns from U.4 cotton far in advance of anything which previous experience of other cottons in Southern Rhodesia has warranted in the past. As it may be, however, that such favourable seasons will not occur with desirable frequency it is as well to know the behaviour of a crop in a season which can fairly be described as having been trying in the extreme, not only to cotton, but to maize and tobacco.

Even now, when the cotton industry is being launched on a fair commercial scale, it would be better to experience only a moderately good season rather than have an unsuspecting farming public again misled by optimum results obtainable only in seasons of rare and irregular occurrence. Even the severe bollworm attack mentioned in the report should be considered as a timely and much-needed hint that by overcoming jassid troubles, which previously constituted the main obstacle to successful cotton growing, the work of the plant-breeder has not come to an end. The absence of severe bollworm attacks in the past tended to lull one into a false sense of security. To know, as we now do, that attacks of American Bollworm may occur with a frequency yet to be experienced, will tend to concentration in the selection of still more prolific and earlier maturing strains. That such strains exist is clearly demonstrated in the Report. That they can be rapidly multiplied and brought into general distribution throughout the Colony, through the co-operation of the more progressive growers, is now no longer a matter of speculation. In 1927 the amount of U.4

cotton seed available for multiplication at Gatooma was 15 lbs. By 1928 this was converted into one ton. In 1929 the one ton has been increased to sixty-five through the whole-hearted co-operation of about sixty Southern Rhodesian farmers. This multiplication, satisfactory in itself, should be considered in the light of the distinctly unfavourable season in which it was accomplished, and should leave no doubt in the minds of those who still consider it an open question whether or not there is a future for cotton-growing in Southern Rhodesia.

This opportunity is taken of reiterating our indebtedness to the continued support of the Government, and the keen interest which they have all along maintained in our work; to the Department of Agriculture for many services courteously rendered; and to the farmers who have so enthusiastically assisted us in our endeavours to get the cotton-growing industry established on a sound and permanent basis.

## COTTON-BREEDING STATION, GATOOMA: REPORT FOR THE SEASON 1928-29.

BY

J. E. PEAT.

The season, though difficult, has been one of distinct progress. Important results have been obtained on the Station, and throughout the country a favourable re-start in the growing of cotton has been made, with U.4.

Climatic conditions have been by no means favourable. Planting rains were late, and cool overcast weather in the early part of the year, giving unsatisfactory growth conditions, made an already late crop even later.

A severe American bollworm attack took place, mainly in April. Developing first on the maize, the attack spread to the cotton as the maize ripened. Of the strains grown only U.4, being a prolific, small-bolled type, was able to set a fair crop. A high percentage of parasitism of the American bollworm larvæ was noted towards the end of the attack. Sudan bollworm was noted in the ratooned trap-crop, but was all but absent in the annual cotton. Jassid was possibly not so severe as in previous seasons, but the susceptible strains succumbed. The resistant strains and re-selections all proved sufficiently satisfactory as regards jassid resistance. The issue of the Special Bulk will ensure more uniformly resistant U.4 for 1930–31. The stainer attack was negligible, but aphis was again troublesome.

The multiplication of U.4 in the districts is considered, for the season, entirely satisfactory. The great care exercised by the majority of the growers is an indication of the interest taken in cotton and, despite the thin seeding, good stands were obtained. Ten-pound packets of U.4 Special Bulk have been issued to one hundred and twenty-four growers for seed plots this coming season.

The reports on last season's U.4 lint are on the whole satisfactory. The unevenness of the yarn and the irregularity of the staple are commented upon. The Special Bulk showed an improvement on the ordinary bulk, and the composite sample from the single-plant selections was definitely the best, showing the improvement that will be effected with the issue of the selected seed. The promise of last year's U.4 selections is being maintained. Some good material is showing up, promising to yield well, high in ginning percentage, and good in staple length. Attention is being paid to lint uniformity within the single-plant lots.

U.4 and the selections from it have again proved completely outstanding. This coming season there will be a fair commercial trial of the ordinary bulk over a wide area of approximately 10,000 acres. If even as successful as in this past year, climatically unfavourable and with a bad American bollworm attack, a considerable acreage will probably be planted in 1930–31. It appears to require an unfavourable combination of conditions to reduce the mean yields of U.4 below a commercial minimum. Continued improvement will be effected by the issues of multiplied single-plant lots from the Station.

### Staff.

The writer took long leave from the end of September, 1928, until March, 1929. Mr. A. H. McKinstry left on study-leave on the 2nd of September, 1929, and Mr. A. N. Prentice joined the staff of the Station on the 2nd of October, 1929. Mr. A. Rattray and Mr. J. Trinder have been appointed by the Rhodesian Government as Farm Foreman and Plant Observer respectively.

### Season.

The rainfall for the past season is depicted in Fig. 1. Only light showers were obtained in November. The 0·84 inches on the 7th of December, supported by the rains on the 9th, 10th and 11th, provided the first chances of planting. The planting date was thus very late. The remainder of December and the first half of January were dry. The young plants, with the thin-seeding rates adopted, found it difficult to break through the crust on the heavier lands, caused by the heavy

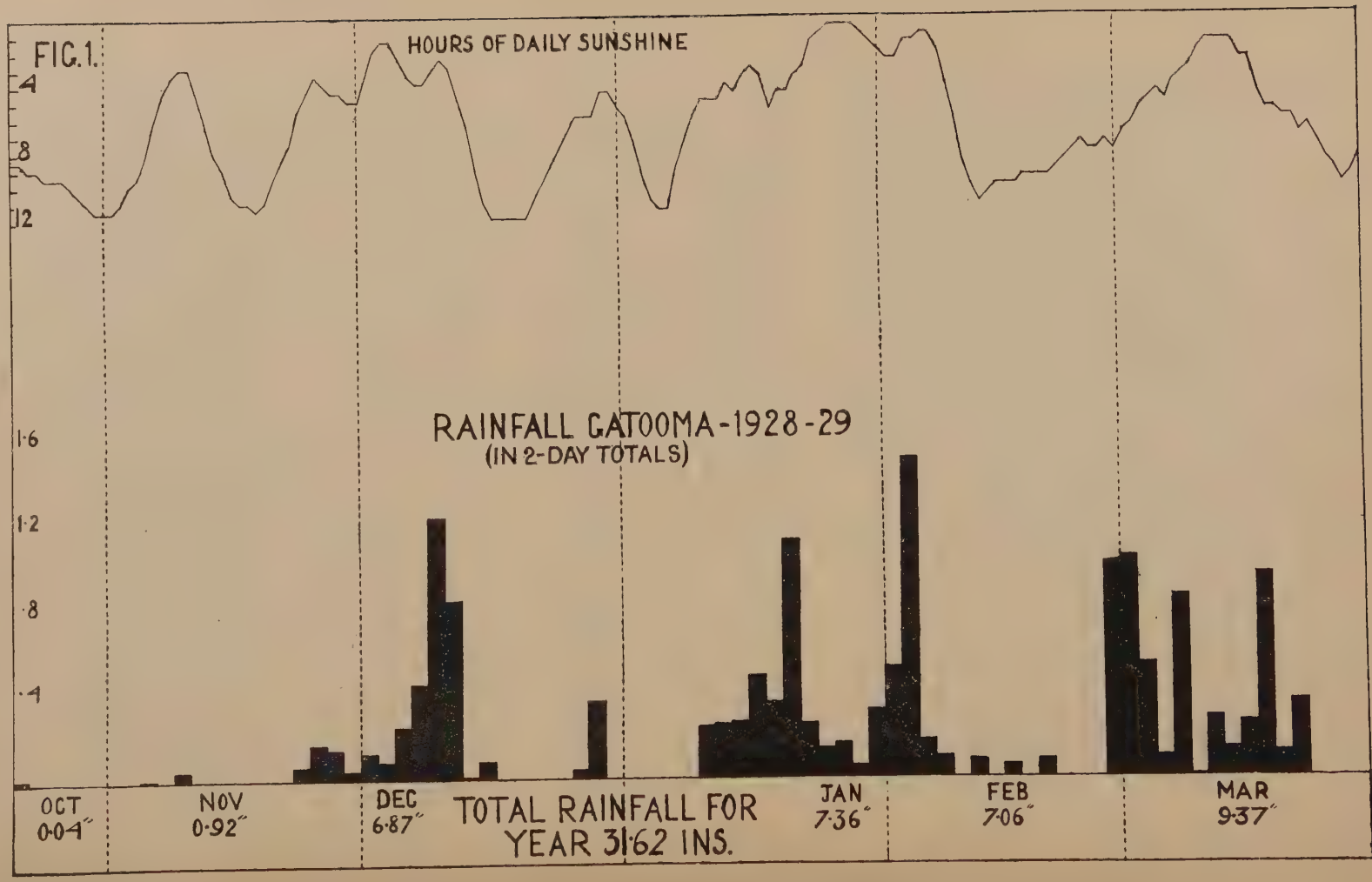


FIG.1.
HOURS OF DAILY SUNSHINE
4
8
12
RAINFALL CATOOMA-1928-29
(IN 2-DAY TOTALS)
1·6
1·2
·8
·4
OCT
0·04″
NOV
0·92″
DEC
6·87″
TOTAL RAINFALL FOR
YEAR 31·62 INS.
JAN
7·36″
FEB
7·06″
MAR
9·37″

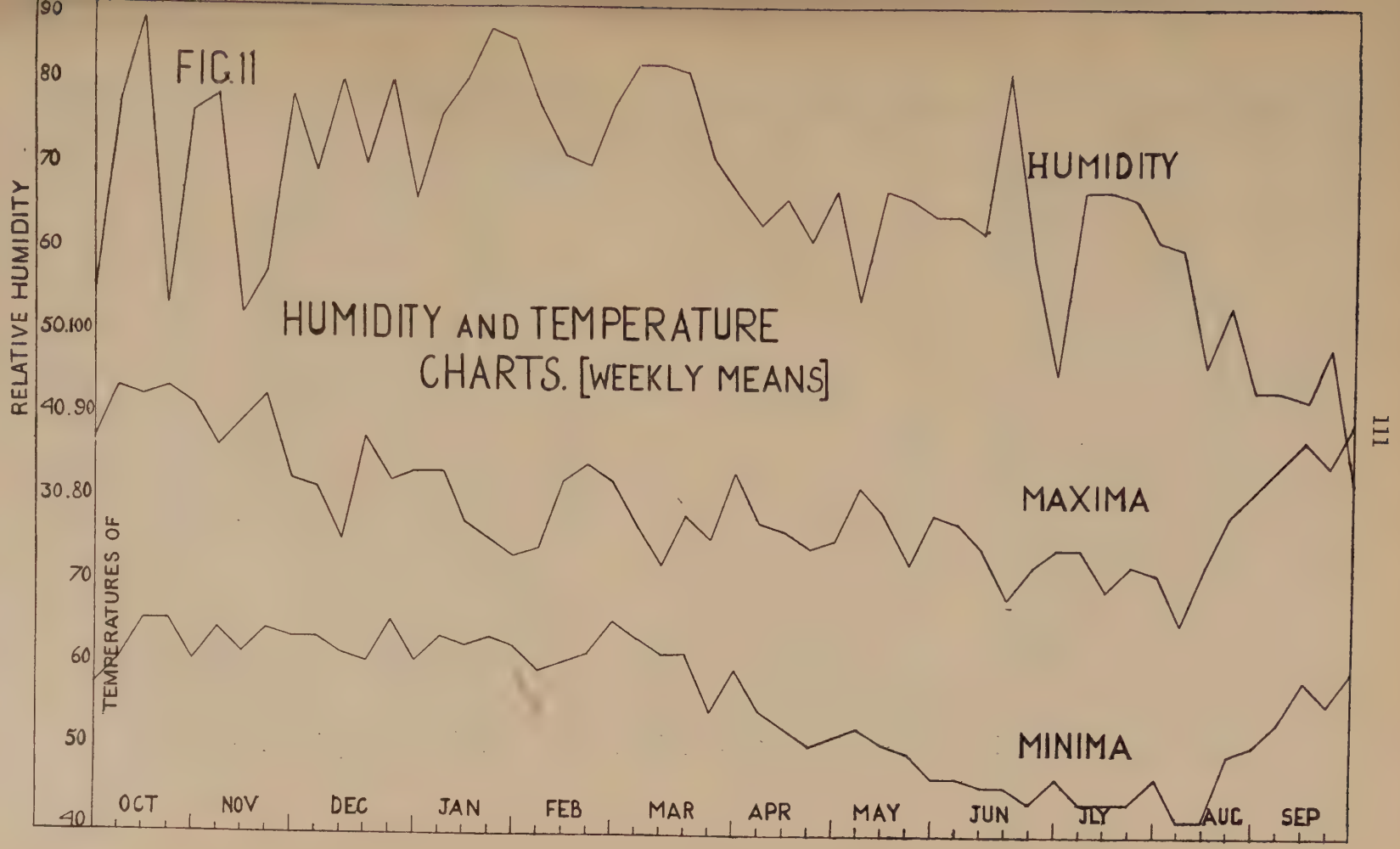


FIG.11
HUMIDITY AND TEMPERATURE
CHARTS. [WEEKLY MEANS]
RELATIVE HUMIDITY
TEMPERATURES OF
HUMIDITY
MAXIMA
MINIMA
90
80
70
60
50.100
40.90
30.80
70
60
50
40
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JLY
AUG
SEP

showers just after planting, and the stands were reduced accordingly. The total rainfall for the season was 31·62 inches.

January and the first half of February were exceptionally cool with much cloudy weather (Figs. I and II). The comparatively low temperatures and the cloudiness, at this, the main growing period, slowed down the growth rate and made an already late crop even later. Temperatures during the latter part of the season were high, and there was very little cold weather. The lowest weekly mean minimum was 42·1° F. in August. The means for June were maximum 74·9° F., minimum 46·2° F., and July maximum 73·4° F., minimum 44·8° F.

### Plant Development Records.

Plant development records were kept for U.4, A.12, and Bancroft in the same way as last year. The record plots were planted on a good even stretch of soil, which had been fallowed the previous season, a practice which is now realised to be bad for cotton. As a result of this, combined with the cool overcast weather, it was the middle of February before the plants started to grow out—much too late for satisfactory growth (Fig. III). This general lateness and poorness of the crop followed by the American bollworm attack render the development records of no detailed interest. Fig. III graphs the growth, flowering, total shedding and bolls maturing. The superiority of U.4 is again demonstrated.

### Insect Attack.

*Jassid.*—Fig. IV shows the jassid distribution for the season. The attack did not appear to be as severe as in the past two years, but only a very small percentage of the acreage under cotton was under susceptible strains, viz,, those intended as a breeding ground for a jassid bombardment to test the other strains. All the U.4 selected material, and most of the other strains selected for resistance, were satisfactory. The susceptible material again succumbed more or less in the order expected.

The upper portion of Fig. IV shows the seasonal jassid distribution for A.12, Bancroft and U.4 in the plant development plots, where a scatter of individual plots existed. Thus a bombardment of the A.12 and U.4 recorded plants was taking place from the contiguous Bancroft plots, raising the level of attack above that obtained in the more isolated plots of these varieties.

The lower portion of the figure gives a comparison, from another portion of the field, of Bancroft with Durango, the most susceptible strain grown.

It was observed in the multiplications of the ordinary bulk U.4, scattered throughout the country, that a proportion of the plants,

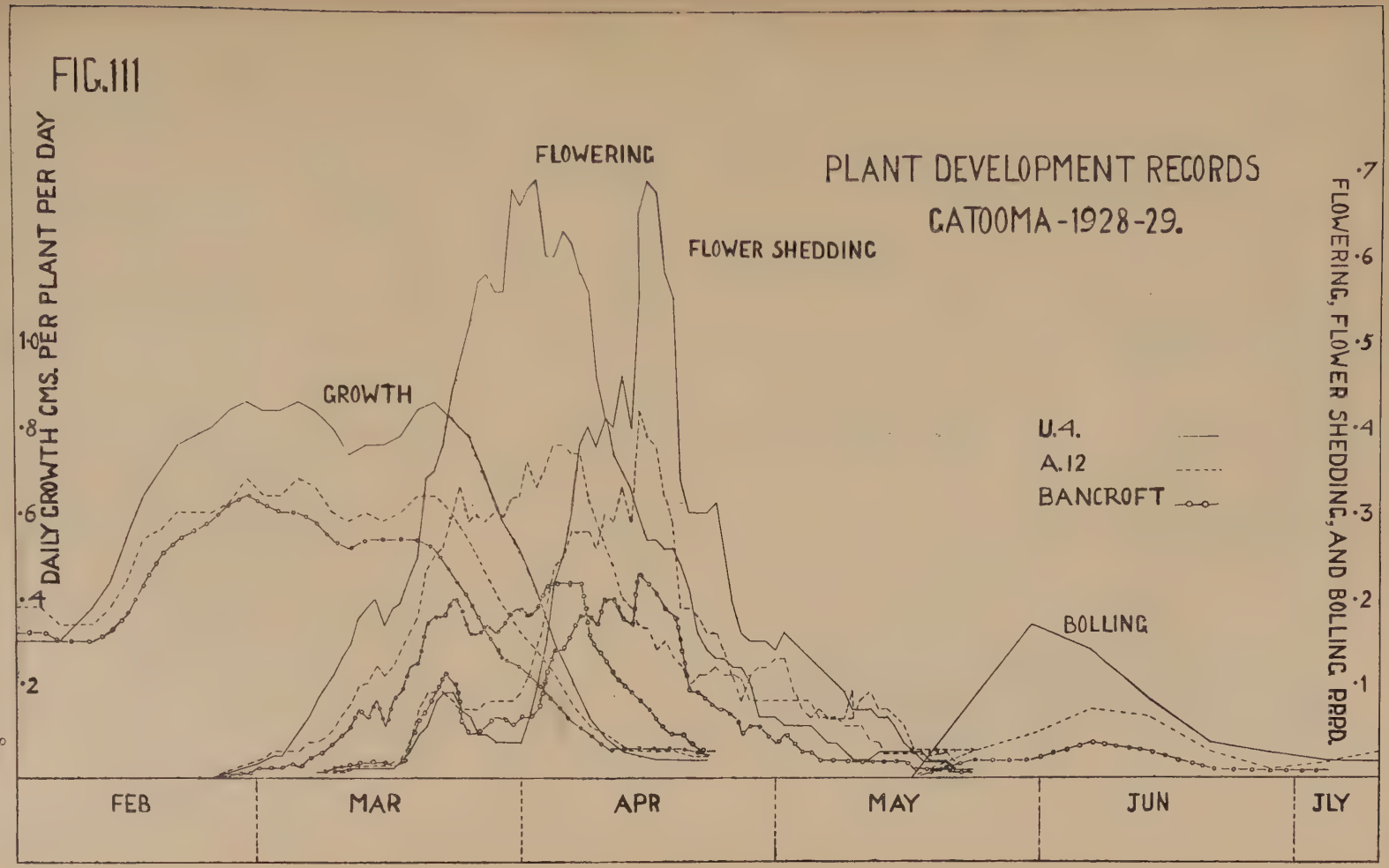


FIG.111
PLANT DEVELOPMENT RECORDS
CATOOMA-1928-29.
FLOWERING
FLOWER SHEDDING
GROWTH
BOLLING
U.4.
A.12
BANCROFT
DAILY GROWTH CMS. PER PLANT PER DAY
FLOWERING, FLOWER SHEDDING, AND BOLLING PRPD.
1·0
·8
·6
·4
·2
·7
·6
·5
·4
·3
·2
·1
FEB
MAR
APR
MAY
JUN
JLY

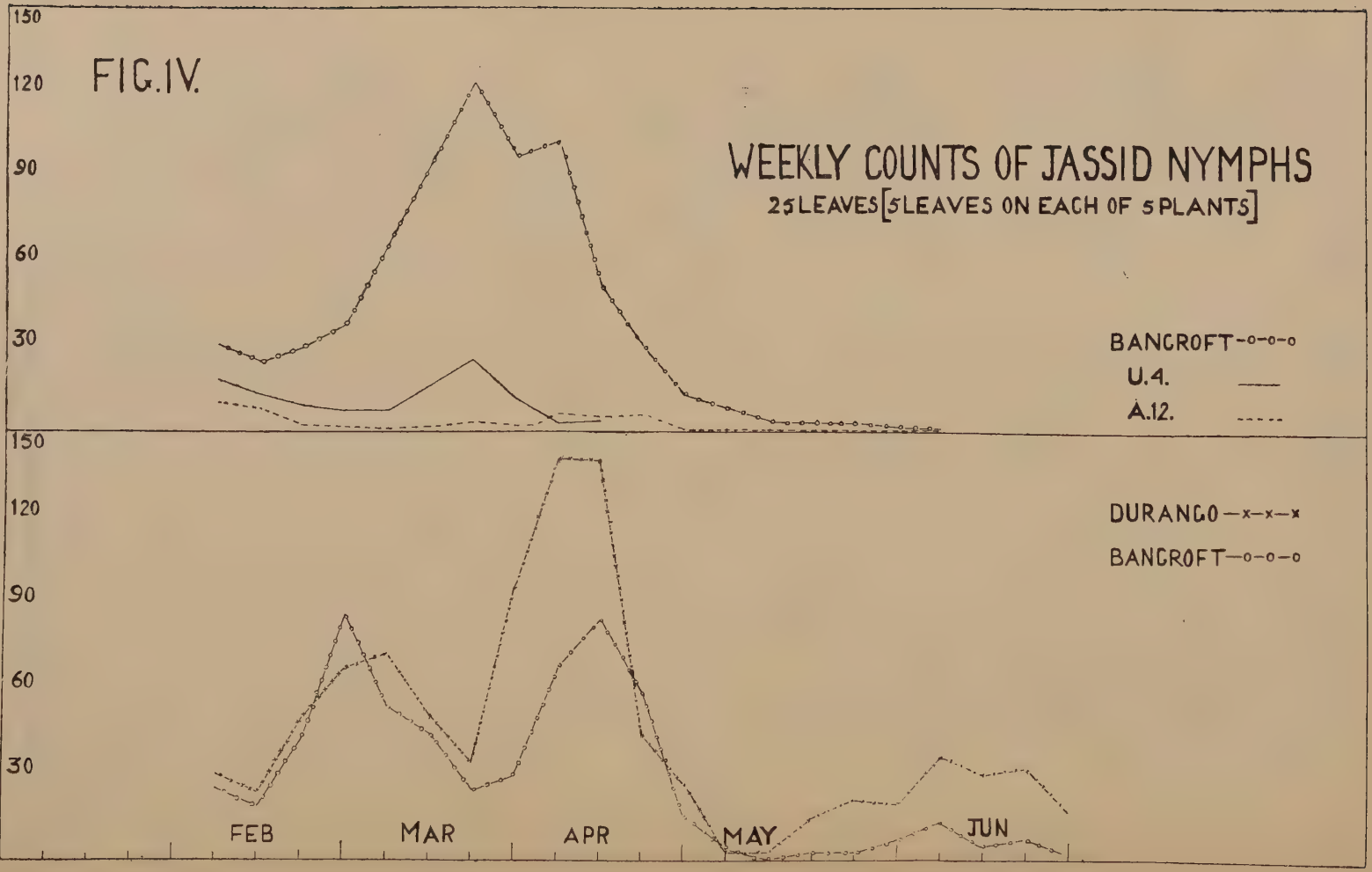


FIG.IV.
WEEKLY COUNTS OF JASSID NYMPHS
25 LEAVES [5 LEAVES ON EACH OF 5 PLANTS]
150
120
90
60
30
BANCROFT -o-o-o
U.4. ——
A.12. - - - -
150
120
90
60
30
DURANGO —x—x—x
BANCROFT —o—o—o
FEB
MAR
APR
MAY
JUN

varying under differing conditions, was showing signs of distress caused by jassid attack. Especially was this noticed where growth was at all rank, and a portion of the multiplication plot shut in by well-grown maize.

On the Station the U.4 Special Bulk was standing up uniformly satisfactorily to jassid. The distribution of this seed for seed plots this coming season, should ensure a good acreage of more uniformly resistant U.4 for the 1930–31 season.

*Bollworms.*—Assuming the jassid problem satisfactorily in hand, the greatest obstacle to complete success would now appear to be the possibility of serious bollworm attack in any one year. On the Station for the past two years, the bollworm attack has been negligible. This year a very severe attack of American bollworm occurred. It should be noted, however, that the Station and one or two neighbouring farms suffered much more heavily than the majority of the U.4 growers, most of whom obtained satisfactory returns; that the general lateness of the crop on the new and the fallowed land, with the consequent poor development mentioned, probably made the attack seem more serious than it would have been under more favourable conditions; and that, despite this, the more prolific U.4 selections gave fair returns.

On the 19th of September a patch of widely spaced cotton, 1·3 acres, was cut back as a ratoon observation trap-crop. On the 17th November a few spiny bollworms were caught. On the 26th November, prior to stripping, a thorough search was made and 180 bollworms were collected, Sudan bollworms (*Diparopsis castanea*) 139, Spiny bollworm (*Earias spp.*) 38, and American bollworms (*Chloridea obsoleta*) 3, a ratio of 46 : 13 : 1. On January 5th, on a further collection, the following bollworm population was obtained, Sudan bollworms 22, Spiny bollworms 10, American bollworms 1. Thus, of the bollworms collected from the ratooned trap-crop, 76 per cent. were Sudan bollworms, the first record of Sudan bollworm on the Station or in the Gatooma District. In contrast, only three Sudan bollworms were obtained in the entire record-taking in the annual cotton, ·001 per cent. of the bollworm population recorded in the observation plots. Unfortunately these were not bred out, but a close study will be made this coming season of the occurrence of Sudan bollworm in the ratooned trap-crop and in the annual, and a proportion of any which may appear will be bred out with a view to recording parasites, possibly acting as a control to Sudan bollworm in the annual cotton under Gatooma conditions. 3·1 per cent. of the bollworms collected in the observation plots were Spiny, a negligible amount contrasted with the American bollworm attack, which was 96·9 per cent. of the total.

In the U.4 plant development record plots, 50 per cent. of the young bolls and flowers which were shed showed bollworm punctures representing 35 per cent. of the flowers formed. No record is available of the loss of flower buds, which must have been high. 23 per cent. of the bolls which reached an opening stage showed bollworm punctures. Fig. V gives the seasonal American bollworm distribution as recorded in the observation plots, and in one hundred scattered plants in the farm block. Daily pickings of bollworms were made from the recorded plants. The records show that there must have been a considerable migration of bollworms during the night. Day after day large numbers of developed bollworms were picked from the same recorded plants. The data therefore probably does not give a clear ultimate expression, but illustrates more the distribution of the attack.

Striking a mean in the one hundred plant group, a population of 12·9 per cent. American bollworms per plant was recorded from the 6th March until the 8th June, 76 per cent. of which, 9·9 per plant, were recorded during April.

Trap-crops of late planted maize had been planted through the cotton. These and the bulk maize were first attacked heavily. The attack on the cotton developed only as the bulk maize hardened up in the ripening. Counts made of American bollworms collected from the late planted trap-crop maize, some twelve acres, illustrate the severity of the attack and the use that may be made of maize trap-crops.

TABLE I.

| *Date.* | *American Bollworms Collected from Maize Trap-Crops (12 Acres Approx.).* |
|---|---|
| March 22–23 ... ... ... ... | 2,346 |
| April 5–6 ... ... ... ... | 25,314 |
| April 16-17 ... ... ... ... | 23,872 |
| TOTAL ... ... ... | 51,532 |

It was probably a mistake to have the maize trap-crop planted through the cotton, more or less drawing the American bollworms into the cotton plots, and aiding any nightly migratory movement of bollworms from maize to adjacent cotton. It would probably be better to have the late planted trap-maize, which is destined for ensilage, planted alongside the bulk maize at two or three different planting dates, and on the side adjoining the cotton. It would appear to be obvious from this year's experience that the American bollworms prefer maize to cotton if the maize is at the right stage. The attack developed on the maize, and only spread to the cotton late as the cobs hardened.

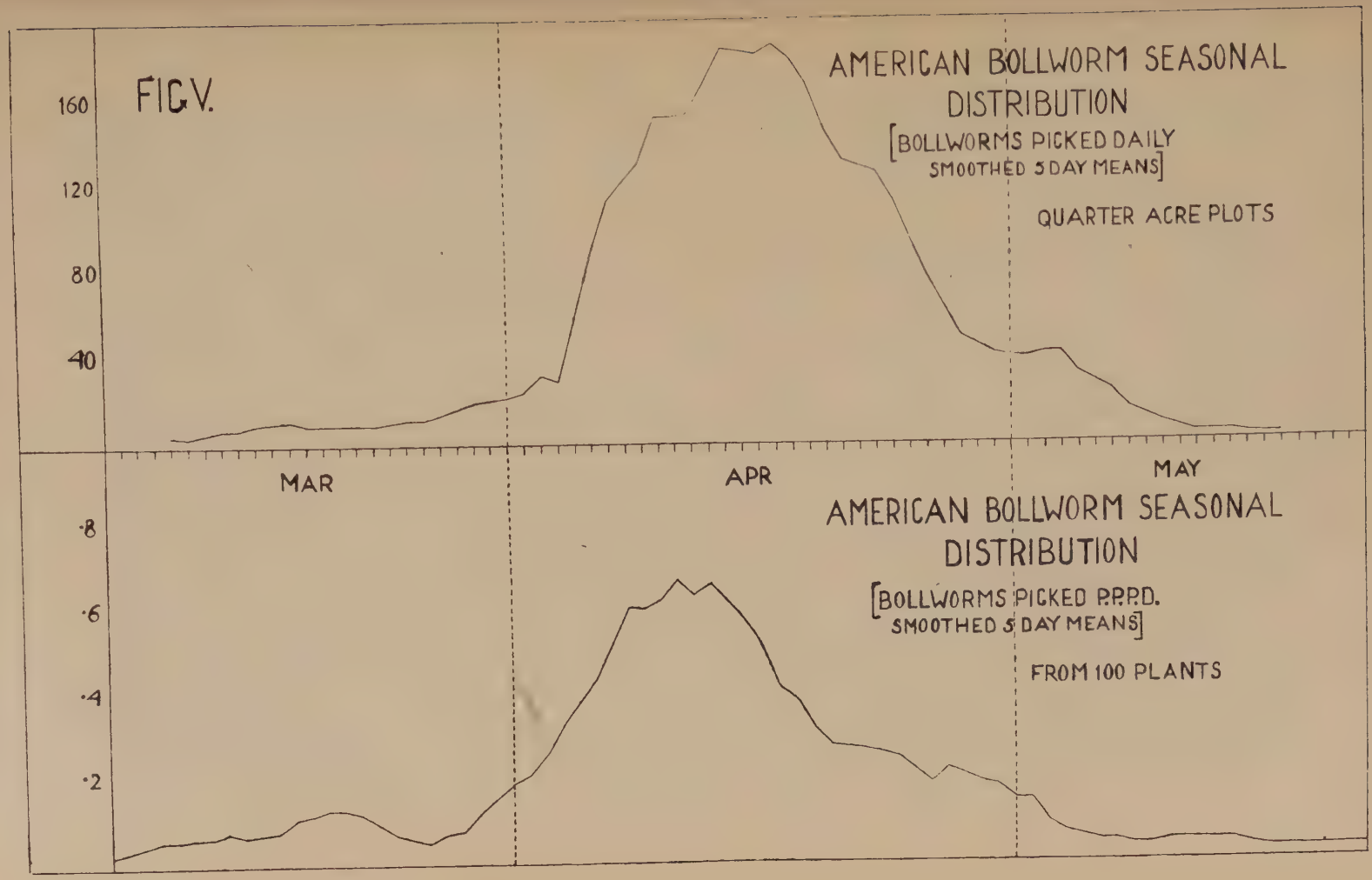


FIG.V.
AMERICAN BOLLWORM SEASONAL DISTRIBUTION
[BOLLWORMS PICKED DAILY SMOOTHED 5 DAY MEANS]
QUARTER ACRE PLOTS
160
120
80
40
MAR
APR
MAY
AMERICAN BOLLWORM SEASONAL DISTRIBUTION
[BOLLWORMS PICKED P.P.P.D. SMOOTHED 5 DAY MEANS]
FROM 100 PLANTS
·8
·6
·4
·2

Collections of American bollworms for breeding out showed in May a high percentage of parasitism by Tachinid parasites, *Sturmia augustifrons*, Vill. (nr.) and *Sturmia munroi*, Curran (nr.). 85 per cent. was the highest figure obtained, but this is probably not strictly accurate as more than one Sturmia was observed hatching from one American bollworm pupa.

Plants were dusted with calcium arsenate and lead arsenate in the middle of April, but this was probably too late. The smaller bollworms in the apices of the plants were killed, but the more developed ones were apparently not affected. To be effective dusting should probably be done when the attack is severe on the maize but yet little developed on the cotton, then the very young emerging larvæ on the cotton would probably be controlled. The American bollworm attack would seem to be sporadic in nature, having been negligible in the past two seasons, and yet severe this one. Possibly with suitable conditions in the early part of the season it is kept in check by Tachinid parasites.

As regards methods of control, further attention will be paid to the use of late-planted maize trap-crops, and dusting at the critical time. But the multiplication of improved strains will probably be of the greatest importance. This season the better U.4 selections carried through a fair crop despite the attack, while very little was obtained from the less prolific Bancroft, Cambodia, and Z.1 Strains. Strains maturing early and prolific in bolls, grown culturally with a view to earliness, will, as shown this season, produce a fair crop in spite of a serious attack.

*Stainers.*—The stainer attack on the Station for the season has been exceedingly mild, possibly due, partly, to the measures taken in the past two years. Throughout the country the stainer attack was later than usual and was light, but farms in the Station area were attacked to a noticeably greater extent than the Station itself. Seed cotton traps were again put down, but the total seasonal picking of stainers over an acreage of about twice that of last season, was less than a week's picking of last year. Some two thousand adult stainers were caught altogether on the traps in two and a half months, and a few broods destroyed. When it was seen how light the attack was very little hand-picking on the plants was done.

Experiments were carried out on the use of various "attractives" on the cotton seed traps, but, with the attack so light, very little information was obtained. Cotton-seed oil, molasses, vanilla in alcohol, aniseed, and orange juice on cotton seed, crushed and uncrushed were tried; the plain cotton seed, crushed and uncrushed, appeared to be the most effective.

*Aphis.*—Aphis again proved a troublesome pest. Periodic small attacks during the growing season developed into a bad attack in April after the rains had ceased. Plants were made unsightly with the honeydew and the soil below the plants was stained with it. Natural enemies, mainly a Dipterous parasite, checked the attack. No method of dealing with an aphis attack on a commercial scale can be suggested, but even an attack of ordinary duration, which looks bad, does not appear to harm the plants very greatly. A few of the selections were recorded as apparently being attacked by aphis to a less extent than the rest.

The measures against the Tenebrionid beetles last season proved effective. Very little trouble was caused by wireworms. Poisoning of the adult beetles, only a few in number, was repeated this season. As in past years a reduction in stand, and a certain destruction of plants, were caused by termites.

### Field Trials.

Fertilizer, spacing and variety trials were laid down on the A.BB.A.CC.A. principle, eight sets of differences being obtained. "Student's" method was used for assessing the significance of the differences. All the trials were laid out on land, fallowed the previous season, which caked badly after planting. Good stands were not obtained, and growth and fruiting were not satisfactory. 200 lbs. per acre and 500 lbs. per acre Bone and Superphosphate gave increased yields, but the mean of neither set of plots was significantly greater than the mean of the plots with no fertilizer dressing. As was to be expected with the poor growth and unsatisfactory stands, 6″ spacing in the row gave significantly heavier yields than 12″, and 12″ than the wider spacings.

In the variety trials the mean U.4 yield was exactly three times the mean yield for Bancroft; there was no significant difference between A.12 and Bancroft.

### U.4.

U.4 and the U.4 selections have again proved completely outstanding compared with the other strains and varieties grown on the Station, and throughout the country. Some 80 per cent. of the multipliers of the ordinary bulk obtained commercially satisfactory yields in a difficult season even with the thin rate of planting used, and seed for some 14,000 acres is available for this coming season.

One hundred and twenty-four packets, 10 lbs. each, of U.4 Special Bulk seed have been issued to farmers for use in seed-plots this coming season; these seed-plots are to provide the bulk seed for their 1930–31 planting.

## 1927–28 Lint Reports.

Samples of U.4 lint, mixed bulk first picking (A) and second picking (B), special bulk first picking (C), and a composite lint sample from 60 single-plant selections (D), were sent home for broker's reports, spinning tests, and a Shirley Institute Report on the measurable characters.

We are very much indebted to Messrs. Wolstenholme and Holland, to the Shirley Institute, and to the firms which carried out the spinning tests.

The brokers' reports are, on the whole, satisfactory. The staple of the samples was given as a good $1\frac{1}{8}''$ to $1\frac{3}{16}''$, medium in strength, rough, wanting in fineness to moderately lustrous. At a time when there was a pressure of staple cottons, U.4 (A and B) was obtaining a premium of 125 to 150 points "on," the special bulk (C) 150 points "on," and the composite sample of lint from selections (D) 170 points "on."

Table II gives the spinning test results. D and C were described as definitely superior to A and B, the final order being D, C, B, A. D was judged a good cotton but probably slightly overspun in the tests. The carding and waste losses were normal. The resulting yarns were described as uneven, B and A being definitely worse in this respect than C and D. When it is remembered that the ordinary bulk U.4 is a heterozygous mixture, that season, 1927–28, was an exceptionally dry one, and that the individual plants, being very widely scattered, produced a heavy yield over a considerable period, the latter portion of which was probably a period of strain, this unevenness of the yarns can be understood. It will most probably be remedied in more normal years with the commercial cultivation of selections from U.4.

TABLE II.

Spinning Test Results.

| *Cotton Sample.* | *Nominal Counts* — *Type of Yarn Spun.* | *Twist Constant.* | *Total Waste %.* | *Strength Tests.* — *Lea Strength in lbs.* | *Work of Rupture in inch lbs. per Lea.* — *Mean.* | *S.D.* | *Count × Strength.* |
|---|---|---|---|---|---|---|---|
| **A.** U.4 Mixed Bulk 1st Picking | 38's Weft | 3·5 | 11·7 | Lea Strength ... | 35·3 | 4·2 | 1249·6 |
| | | | | Work of Rupture | 38·6 | 4·4 | 1366·4 |
| | | | | Actual Count ... | 35·4 | ·8 | — |
| **B.** U.4 Mixed Bulk 2nd Picking | Do. | 3·4 | 11·1 | Lea Strength ... | 46·6 | 3·9 | 1733·5 |
| | | | | Work of Rupture | 72·5 | 3·8 | 2697·0 |
| | | | | Actual Count ... | 37·2 | ·4 | — |
| North Georgia Control | Do. | 3·4 | 11·3 | Lea Strength ... | 35·1 | 1·5 | 1333·8 |
| | | | | Work of Rupture | 54·5 | 3·1 | 2071·0 |
| | | | | Actual Count ... | 38·0 | 1·0 | — |

| Cotton Sample. | Nominal Counts: Type of Yarn Spun. | Twist Constant. | Total Waste. % | Strength Tests. | | | |
|---|---|---|---|---|---|---|---|
| | | | | Lea Strength in lbs. | Work of Rupture in inch lbs. per Lea. Mean. | S.D. | Count × Strength. |
| **C.** U.4 Special Bulk 1st Picking | 46's Twist | 3·6 | 12·5 | Lea Strength ... | 33·5 | 2·0 | 1514·2 |
| | | | | Work of Rupture | 53·8 | 3·4 | 2431·8 |
| | | | | Actual Count ... | 45·2 | ·5 | — |
| **D.** U.4 Composite Selection Sample | Do. | 3·6 | 11·8 | Lea Strength ... | 35·5 | 2·3 | 1611·7 |
| | | | | Work of Rupture | 55·4 | 2·0 | 2515·2 |
| | | | | Actual Count ... | 45·4 | ·7 | — |
| Memphis Control | Do. | 3·7 | 12·4 | Lea Strength ... | 42·5 | 2·1 | 1797·8 |
| | | | | Work of Rupture | 69·2 | 3·1 | 2927·2 |
| | | | | Actual Count ... | 42·3 | ·7 | — |

Table III gives the results of Immaturity Tests (British Cotton Industry Research Association) on four of the samples, four single-plant selections, and three controls. Baer diagrams were also made for the U.4 lint lots. The falling away in staple length over the three pickings is demonstrated. U.4/123 is markedly the best selection in the test.

TABLE III.

IMMATURITY TESTS (B.C.I.R.A.).

| Cotton Sample. | % below 1 cm. | % Number of Hairs. Normal. | Thin-walled. | Dead. | Baer Diagram. Mean. ins. | Mode. ins. | Coefficient of Variability. | Modal Group Per-centage. |
|---|---|---|---|---|---|---|---|---|
| U.4 Mixed Bulk 1st Picking ... | 13 | 52 | 33 | 15 | 0·80 | 1·05 | 39·8 | 37·2 |
| U.4 Mixed Bulk 2nd Picking ... | 11 | 44 | 43 | 13 | 0·85 | 0·95 | 36·8 | 35·4 |
| U.4 Mixed Bulk 3rd Picking ... | 11 | 20 | 63 | 17 | 0·75 | 0·90 | 39·0 | 32·7 |
| U.4 Special Bulk 1st Picking ... | 13 | 38 | 38 | 24 | 0·73 | 0·90 | 40·7 | 36·6 |
| U.4/40 ... ... | 5 | 34 | 50 | 16 | 0·93 | 1·20 | 39·4 | 37·0 |
| U.4/85 ... ... | 4 | 51 | 42 | 7 | 0·96 | 1·15 | 37·7 | 36·7 |
| U.4/107 ... ... | 5 | 47 | 42 | 11 | 1·02 | 1·25 | 37·1 | 37·5 |
| U.4/123 ... ... | 8 | 69 | 26 | 5 | 1·03 | 1·20 | 37·4 | 42·5 |
| American Arizona | — | 61 | 30 | 9 | — | — | — | — |
| American Texas... | — | 77 | 19 | 4 | — | — | — | — |
| Texas SGM-MF... | — | 62 | 29 | 9 | — | — | — | — |

The measureable characters as determined by the British Cotton Industry Research Association are set out in Table IV. The irregularity of the staple is stressed, the hair lengths in B being so irregular that the mode or most frequent hair length bears no relation to staple length as understood by the spinner, which is therefore not given. Sample C was judged slightly more regular, and D the most satisfactory, thus confirming the spinning tests for this cotton. The irregularity mentioned, will, it is hoped, be remedied greatly by the work of the next few years.

The tests point to the improvement in lint uniformity, irrespective of its other qualities, of the special bulk as compared with the ordinary mixed bulk, and the increasing uniformity which will be obtained in the selections now coming on.

TABLE IV.

MEASURABLE CHARACTERS (B.C.I.R.A.).

| *Cotton Sample.* | *Staple Length. (ins.) (Most Frequent Hair Length.)* | *Mean Hair Length. (mms.)* | *Breaking Load. (grammes.)* | *Hair Wt. per Cm. (mgm.)* | *Remarks.* |
|---|---|---|---|---|---|
| **A.** U.4 Mixed Bulk 1st Picking ... | $1\frac{1}{8}$" bare | 19·5 | 4·2 | 0·00184 | Irregular staple. |
| **B.** U.4 Mixed Bulk 2nd Picking ... | — | 18·6 | 3·7 | 0·00176 | Very irregular staple. |
| **C.** U.4 Special Bulk 1st Picking ... | 1" to $1\frac{1}{8}$" | 20·3 | 4·2 | 0·00202 | Slightly more regular. |
| **D.** U.4 Composite Selection Sample | $1\frac{3}{16}$" | 22·2 | 4·1 | 0·00191 | The most satisfactory of the U.4 samples. |
| Memphis Control | $1\frac{1}{8}$" bare | 23·4 | 4·1 | 0·00175 | |
| N. Georgia Control | $\frac{7}{8}$" | 20·2 | 5·0 | 0·00214 | |

U.4 SINGLE PLANT SELECTIONS AND RE-SELECTIONS.

One hundred and thirty-six U.4 single-plant lots were planted out this past season. Twenty-four lots showing the more promising parent characters on analysis were labelled A. All the seed was planted, single seeds 4 ft. by 3 ft., and the complete single-plant lot selfed throughout the season. The B's consisted of forty-three lots; half the seed was planted and five rows in each plot were selfed. A few lines of each of the remaining lots were planted, and as much selfing

as could be undertaken was done. Thus, though there was selfed seed from all the lots, the intensive selfing was concentrated in the more promising lots.

The great work of the Station in the next few years must be the issue of seed from higher yielding, uniformly jassid-resistant strains, of good ginning percentage, good staple length, and good lint uniformity. Some very satisfactory material is beginning to show up in the U.4 selections, already surprisingly uniform for first selection multiplications. Within the better lots in the field there is a fair uniformity in the vegetative characters, and the laboratory analyses show a good degree of uniformity in ginning percentages and lint lengths.

A number of distinct vegetative types are represented amongst the selections and it will be a year or two before it is possible to separate out clearly the more desirable from the less desirable. One, a bushy, vegetative, prolific looking type is already showing up as undesirable under this season's conditions. Each lot of this type has shown itself to be a bad opener.

U.4/26, U.4/64, probably the two best lots of medium staple, and U.4/130, will be bulked this coming season, being sown as single seeds at wide spacing, for possible seed plot issue in the 1930–31 season. Some nineteen others, possessing desirable qualities, the best of which are probably U.4/20, U.4/33, U.4/41, U.4/117, U.4/119 and U.4/123, will be grown in observation bulks.

At this stage the primary qualities to be considered are (taking jassid-resistance for granted) yielding power, high ginning percentage, lint length above a minimum, but below a maximum figure, and lint uniformity. It is possible that, later, the strains multiplied will be considerably longer in staple than those first issued. It will be necessary to grow fairly pure lots of the longer stapled lines for a number of years under observation before any question of their issue can be considered. Taking lots around 30 mms., only those which are prolific and have satisfactory ginning percentages are being continued.

In all, some one hundred and eighty U.4 re-selections will be carried on. Lint from about eight single-plant lots and a sample of special bulk lint, grown on the Station this past season, will be sent home for brokers' opinions and spinning tests.

Tables V, VI and VII set out the characters of re-selections within some of the better single-plant lots, and from these the characters and uniformity of the lots themselves can be determined.

The single-plant yields are very low, but contrasted with strains other than U.4 are, on the whole, satisfactory. Several of the lots were growing on new land broken up early the season before, and most of

TABLE V.

PRIMARY U.4 SELECTIONS.

| Strain. | Weight of seed cotton per plant. | | | | Mean Max. Lint Length in mms. | Ginning %. | | | Lint Index. | Mean Wt. 100 seeds in gms. | Baer Diagram. | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Pick 4–11 June. | 2nd Pick 15–18 July. | 3rd Pick 23–24 Aug. | Total. | | From well-opened bolls. 1st Pick. | From remainder of 1st Pick. | From Total 2nd Pick. | | | Mean ins. | Mode ins. | Coefficient of Variability. | Modal Group %. | |
| U.4/26/1 ... ... | 55·3 | 13·0 | — | 68·3 | 33·4 | 39·3 | 39·6 | 34·7 | 5·27 | 8·14 | ·84 | ·95 | 36·3 | 35·4 | Prolific early maturing strain Stunted on new land. |
| 2 ... ... | 50·8 | 8·2 | — | 59·0 | 31·8 | 38·9 | 39·2 | 37·3 | 5·78 | 9·06 | ·93 | 1·05 | 29·7 | 39·0 | |
| 3 ... ... | 56·9 | 6·7 | — | 63·6 | 30·2 | 39·4 | 40·0 | 43·4 | 5·78 | 8·90 | ·90 | 1.05 | 36·5 | 34·5 | |
| 4 ... ... | 83·2 | 3·2 | — | 86·4 | 30·6 | 41·0 | 39·8 | 37·2 | 5·50 | 7·90 | ·87 | ·95 | 34·0 | 34·7 | |
| Plant lot means total 5 re-selections ... | 59·5 | 7·8 | — | 65·7 | 31·2 | 39·6 | 39·4 | 38·1 | 5·70 | 8·7 | — | — | — | — | |
| U.4/64/1 ... ... | 63·0 | 22·5 | 6·3 | 91·8 | 30·8 | 35·9 | 37·1 | 36·5 | 6·01 | 10·75 | ·87 | 1·00 | 31·8 | 49·5 | Very prolific, early maturing strain, carrying and opening well. |
| 4 ... ... | 54·8 | 67·9 | — | 122·7 | 33·2 | 35·7 | 37·0 | 37·6 | 5·68 | 10·25 | ·90 | 1·05 | 27·3 | 38·7 | |
| 5 ... ... | 64·5 | 38·8 | — | 103·3 | 31·0 | 36·1 | 36·6 | 37·0 | 5·90 | 10·46 | ·95 | 1·10 | 30·1 | 42·5 | |
| Plant lot means total 10 re-selections ... | 68·6 | 33·9 | 3·9 | 103·3 | 31·1 | 35·0 | 35·6 | 34·9 | 5·27 | 9·82 | — | — | — | — | |
| U.4/130/1 ... ... | 51·8 | 4·8 | — | 56·6 | 31·3 | 38·8 | 38·4 | 36·6 | 6·30 | 10·00 | ·91 | 1·00 | 30·1 | 54·0 | Vigorous strain uniform in vegetative and lint characters. |
| 2 ... ... | 64·9 | 20·3 | — | 85·2 | 31·7 | 38·2 | 35·8 | 39·3 | 6·20 | 10·10 | ·92 | 1·10 | 30·8 | 45·5 | |
| 4 ... ... | 74·2 | 30·0 | — | 104·2 | 33·6 | 37·4 | 37·7 | 37·3 | 6·90 | 11·50 | ·93 | 1·10 | 35·9 | 44·0 | |
| 5 ... ... | 37·8 | 8·3 | — | 46·1 | 32·4 | 37·4 | 37·0 | 33·5 | 6·00 | 10·10 | ·85 | 1·00 | 34·2 | 40·4 | |
| Plant lot means total 6 re-selections ... | 49·6 | 18·2 | — | 67·8 | 32·3 | 37·9 | 37·1 | 37·3 | 6·5 | 10·75 | — | — | — | — | |

TABLE VI.

U.4 Selections (Medium Staple).

| Strain. | Weight of seed cotton per plant. | | | | Mean Max. Lint Length in mms. | Ginning %. | | | Lint Index. | Baer Diagram. | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Pick 4–11 June. | 2nd Pick 15–18 July. | 3rd Pick 23–24 Aug. | Total. | | From well-opened bolls. 1st Pick. | From remainder of 1st Pick. | From Total 2nd Pick. | | Mean Wt. 100 seeds in gms. | Mean ins. | Mode ins. | Coefficient of Variability. | Modal Group %. | |
| U.4/92/1 ... ... | 29·0 | 19·3 | — | 48·3 | 30·0 | 40·6 | 41·0 | 37·4 | 6·99 | 10·18 | ·87 | 1·05 | 35·2 | 38·7 | |
| 2 ... ... | 38·6 | 17·6 | — | 56·2 | 33·4 | 37·7 | 38·6 | 40·2 | 5·68 | 9·4 | ·89 | 1·00 | 29·7 | 48·8 | |
| 3 ... ... | 65·9 | 17·4 | — | 83·3 | 31·6 | 38·5 | 39·0 | 34·0 | 6·66 | 10·68 | ·85 | ·90 | 32·8 | 43·0 | Good even on new land. |
| Plant lot means total 4 re-selections ... | 45·4 | 21·0 | 4·6 | 71·1 | 31·7 | 38·7 | 39·4 | 36·8 | 6·40 | 10·13 | — | — | — | — | |
| U.4/106/2 ... ... | 49·0 | — | 0·4 | 49·4 | 28·0 | 39·2 | 38·7 | — | 5·83 | 9·06 | ·88 | ·95 | 28·7 | 46·6 | Prolific, but growing on a poor patch of land. Parent medium length staple. |
| 3 ... ... | 41·1 | — | — | 41·1 | 28·0 | 37·7 | 38·0 | — | 6·00 | 9·88 | ·91 | 1·05 | 28·4 | 44·6 | |
| Plant lot means total 3 re-selections ... | 43·5 | 2·4 | 2·7 | 48·6 | 28·5 | 38·2 | 38·4 | 32·5 | 5·85 | 9·48 | — | — | — | — | |
| U.4/117/1 ... ... | 41·8 | 2·0 | — | 43·8 | 28·4 | 40·4 | 40·6 | 34·5 | 6·13 | 9·09 | ·79 | ·80 | 33·2 | 42·5 | Growing on a poor patch of land. Parent medium length of staple. |
| 2 ... ... | 41·9 | 3·3 | — | 45·2 | 29·4 | 41·5 | 41·8 | 35·1 | 6·79 | 9·59 | ·84 | 1·00 | 28·5 | 51·2 | |
| 3 ... ... | 58·1 | 9·3 | 5·6 | 73·0 | 28·2 | 40·3 | 41·2 | 31·2 | 6·47 | 9·60 | ·78 | ·80 | 30·5 | 52·5 | |
| Plant lot means total 4 re-selections ... | 45·2 | 5·6 | 1·4 | 52·2 | 28·5 | 40·5 | 41·0 | 35·5 | 6·33 | 9·32 | — | — | — | — | |
| U.4/119/1 ... ... | 63·2 | 29·7 | 3·1 | 96·0 | 30·8 | 37·0 | 36·9 | 36·5 | 6·20 | 10·50 | ·86 | 1·00 | 32·9 | 38·2 | |
| 2 ... ... | 77·3 | 27·1 | — | 104·4 | 32·8 | 37·5 | 37·5 | 38·7 | 6·70 | 11·20 | ·83 | 1·00 | 34·8 | 36·0 | Marked uniformity of vegetative characters. |
| 3 ... ... | 85·9 | 30·1 | — | 116·0 | 33·2 | 36·0 | 36·3 | 37·6 | 5·50 | 9·80 | ·91 | 1·05 | 30·3 | 39·0 | |
| 5 ... ... | 61·6 | 30·5 | — | 92·1 | 31·0 | 38·2 | 39·2 | 37·7 | 5·90 | 9·60 | ·92 | 1·00 | 27·6 | 50·0 | |
| Plant lot means total 5 re-selections ... | 70·5 | 35·5 | 1·9 | 107·9 | 32·0 | 36·8 | 37·1 | 37·6 | 6·00 | 10·30 | — | — | — | — | |
| U.4/123/1 ... ... | 41·9 | 98·9 | — | 140·8 | 33·6 | 37·0 | 37·3 | 34·0 | 7·20 | 12·20 | ·92 | ·95 | 31·5 | 37·5 | |
| 2 ... ... | 55·7 | 73·7 | 17·6 | 147·0 | 33·0 | 36·8 | 35·7 | 36·8 | 6·40 | 10·97 | ·98 | 1·20 | 31·6 | 35·5 | Prolific and uniform, but with a tendency to laxness. |
| 4 ... ... | 47·3 | 52·9 | — | 100·2 | 31·3 | 36·4 | 36·4 | 37·7 | 7·00 | 12·30 | ·87 | 1·00 | 34·7 | 38·5 | |
| Plant lot means total 4 re-selections ... | 43·5 | 62·6 | 4·4 | 110·5 | 32·4 | 36·7 | 36·5 | 36·2 | 6·90 | 11·82 | — | — | — | — | |

## TABLE VII.

U.4 Selections (Longer Staple).

| Strain. | Weight of seed cotton per plant. | | | | Mean Max. Lint Length in mms. | Ginning %. | | | Lint Index. | Baer Diagram. | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st Pick 4–11 June. | 2nd Pick 15–18 July. | 3rd Pick 23–24 Aug. | Total. | | From well-opened bolls. 1st Pick. | From remainder of 1st Pick. | From Total 2nd Pick. | | Mean Wt. 100 Seeds in gms. | Mean ins. | Mode ins. | Coefficient of Variability. | Modal Group %. | |
| U.4/33/1 ... ... | 73·8 | 4·7 | 2·0 | 80·5 | 33·2 | 42·0 | 40·8 | 39·6 | 6·97 | 9·61 | ·95 | 1·00 | 28·5 | 52·2 | Medium strain good combination of lint length and ginning percentage. |
| 2 ... ... | 55·7 | 23·9 | 11·7 | 91·3 | 32·8 | 40·0 | 40·0 | 36·6 | 7·25 | 10·88 | ·90 | 1·00 | 30·3 | 43·3 | |
| Plant lots means total 2 re-selections ... | 64·7 | 14·3 | 6·8 | 85·9 | 33·0 | 41·0 | 40·4 | 38·1 | 7·11 | 10·24 | — | — | — | — | |
| U.4/41/1 ... ... | 40·9 | 20·6 | 10·4 | 71·9 | 35·4 | 35·9 | 36·8 | 36·2 | 5·84 | 10·44 | ·83 | 1·00 | 35·0 | 32·7 | Vigorous to bushy long stapled strain. |
| 2 ... ... | 53·0 | 95·3 | — | 148·3 | 35·6 | 34·2 | 35·1 | 36·5 | 5·60 | 10·79 | ·89 | ·95 | 30·0 | 37·7 | |
| 3 ... ... | 77·2 | 27·1 | — | 104·3 | 34·8 | 34·7 | 35·2 | 34·1 | 5·60 | 10·52 | 1·03 | 1·10 | 32·1 | 40·4 | |
| Plant lot means total 3 re-selections ... | 57·0 | 47·7 | 3·5 | 108·2 | 35·3 | 34·9 | 35·7 | 35·6 | 5·70 | 10·58 | — | — | — | — | |
| U.4/80/2 ... ... | 65·4 | 23·9 | — | 89·3 | 35·4 | 35·4 | 35·8 | 37·1 | 5·35 | 9·78 | 1·02 | 1·05 | 25·2 | 42·5 | Good re-selection. |
| U.4/89/1 ... ... | 55·0 | 3·0 | — | 58·0 | 33·8 | 36·6 | 37·5 | 37·6 | 5·16 | 8·94 | ·78 | ·85 | 41·5 | 28·3 | Vigorous, big disparity compared with other re-selections, between mean maximum lint lengths and modes, and means of Baer Diagrams. |
| 2 ... ... | 55·6 | 5·8 | — | 61·4 | 34·0 | 34·4 | 36·7 | 36·5 | 5·35 | 10·24 | ·79 | ·80 | 38·3 | 28·4 | |
| 3 ... ... | 41·4 | 37·1 | — | 78·5 | 34·0 | 36·2 | 36·9 | 38·7 | 6·04 | 10·61 | ·83 | ·95 | 42·5 | 26·7 | |
| Plant lot means total 4 re selections ... | 54·5 | 16·8 | 1·8 | 73·1 | 33·0 | 37·1 | 38·3 | 37·3 | 5·92 | 9·97 | — | — | — | — | |
| U.4/99/2 ... ... | 64·2 | 30·4 | 5·6 | 100·7 | 38·6 | 32·4 | 32·4 | 34·1 | 5·52 | 11·50 | 1·08 | 1·30 | 35·8 | 31·8 | Exceptionally long staple. |

the remainder on land fallowed the previous season, a practice now known to be unfavourable to good production. With the late season experienced, the plants did not grow out well, and the severe American bollworm attack reduced the yield to a mere fraction of what it might have been.

The lint characters have been recorded more or less as in past years. The lint length has been measured on five seeds picked at random from the " well-opened bolls " material. In addition, in a number of the re-selections, lint length estimations were made for individual well-opened bolls from the same plant. In some of the re-selections, there was a length variation from boll to boll of the same picking, which is worthy of further and closer study. But the mean figure obtained from the five measurements is probably sufficient for purposes of first selection comparisons, greater numbers being taken for closer examinations. Lint length examinations on the second picking show a falling away in length under this season's conditions.

Ginning percentages, lint indices and seed weights were calculated as last year from 300 seeds, or from less, if 300 were not available, from the " well-opened bolls " material, the optimum expression for these characters. The ginning percentages for the total first, second, and third pickings were calculated for comparison. The ginning percentages on the total first and second pickings, and the calculated ginning percentages from the " well-opened bolls " material, approximate fairly closely, and are, in the main, satisfactorily high. There is a decline in the ginning percentages for the third picking.

A quality, multiple in its contributory aspects, which it is desirable to establish in Rhodesian cotton as early as possible is lint uniformity. A start has been made with the analyses of lint uniformity within the U.4 selections by the making of Baer diagrams of the better re-selections, to be followed up in later years, as the material gets more homozygous, by diagrams of the plant lot lint. The individual diagrams are the best comparisons, but in addition, for record purposes the Coefficient of Variation (100 $\sigma$/M) for each diagram has been calculated as well as the " Modal Group Percentage," *i.e.*, the percentage number of hairs grouped $\frac{1}{8}''$ above or below the observed diagram mode, an arbitrary amount, but useful for comparisons. The coefficient of variation is really only strictly accurate for comparisons within a limited lint length group (Tables VI and VII). It is not strictly accurate to compare the coefficients of variation of long and short stapled selections.

The better families show, within the lot, a satisfactory agreement and uniformity of type in the diagrams, which to some extent is expressed in the diagram figures in Tables V, VI and VII. Of the

shorter lots U.4/106 and U.4/117, of the medium lots, U.4/64, U.4/130, and U.4/119, and of the longer lots U.4/33 and U.4/80/2 are among the most uniform. U.4/89 is especially irregular, with a high co-efficient of variation and a low modal group percentage.

There is a disparity between the comparative magnitude of the mean maximum lint length figures and the Baer diagram figures for modes and means in a number of the re-selections, which appears to show the limited usefulness of the mean maximum figure, with irregular material, and the necessity for closer examination of the better selections. Re-selections recorded as having medium short mean maximum lint lengths, for example U.4/106, showed higher Baer diagram modes and means than re-selections recorded as having very considerably longer mean maximum lint lengths, for example U.4/89. As was shown in the diagrams, a relatively small proportion of long hairs created a totally false impression of the staple length of the selection, as judged by mean maximum lint length measurements.

### Other Strains.

Not one of the strains other than U.4 gave satisfactory results. One hundred and five selections from Bancroft, A.12, Zululand Hybrid and Cambodia were planted out. A few re-selections have been made from the better ones, more with the idea of retaining observation material for a few more years than with much hope of evolving a substitute to the U.4 selections. The A.12 grown commercially in the district did not turn out so satisfactorily as the U.4 multiplications.

The lateness of the season was unfavourable to Cambodia, itself a late strain. It would now appear that practically all, if not all, the more compact early-maturing selections of the past two seasons were in reality crosses with non-jassid-resistant material, and, as such, are now segregating for resistance, habit, and the other characters.

The bigger bolled type of the strains other than U.4, and their less prolific nature, rendered them less able to stand up to the American bollworm attack; the single-plant yields are very low.

### Rotation Crops.

The main rotation crop grown is maize. The season was favourable for maize, and on the Station, especially where grown after cotton, the yields were good. The mean yield for the Station was just over 13 bags, 2,620 lbs. to the acre. Forty-four acres were planted to Sunn Hemp, ploughed in green and a further plot was grown for seed.

SOUTHERN RHODESIA.

The best farm multiplication of U.4 seed. From the farm belonging to J. A. O. Fraser-Mackenzie, Esq., Lomagundi.
Seed issued—30 lbs.: Seed return—11,279 lbs.: Multiplication—376 fold:
Yield-per-acre (with single seed planting)—767 lbs. seed cotton.

The Gatooma Spanish Bunch groundnuts were tested in variety trials against a late maturing Nyasaland Native obtained from Ducker. Trouble has been experienced in the past few years with " Spanish Bunch " on the Station. The last rains have caused the nuts to sprout at a time when it is usually inconvenient to use the labour for lifting them. It was thought that the use of a late-maturing nut such as this might get over the difficulty. The growth of top on the Nyasaland Native was excellent, but the mean yield worked out at only 66 per cent. of that of the " Spanish Bunch " :—Spanish Bunch mean plot yield 50·0 lbs. per plot $\pm$ S.E. 1·7 (1,500 lbs. nuts per acre). Nyasaland Native 32·8 lbs. per plot $\pm$ S.E. 1·4 (1,000 lbs. of nuts per acre), mean plot difference 17·2 lbs. $\pm$ S.E. 2·24.

# NORTHERN RHODESIA.

## REPORT ON THE WORK ON COTTON AT THE RESEARCH STATION, MAZABUKA, SEASON 1928-29.

INTRODUCTORY NOTE BY T. McEWEN.

The following report on the work on cotton at the Research Station is by Mr. A. G. Bebbington, the Cotton Selection Officer sent out by the Empire Cotton Growing Corporation in October, 1928, who has been in charge of the cotton work since his arrival. The entomological portion of the report is by Mr. W. Allan, the Assistant Agricultural Research Officer, who commenced duty with the Agricultural Department in late December, 1928, and who, since then, has collaborated with Mr. Bebbington in the work on cotton.

The period under review may be regarded as of somewhat special interest in that it is the first season in which it has been possible to afford that detailed study to any of the many problems with which cotton cultivation in Northern Rhodesia abounds, without which little hope of their eventual solution can be entertained. As it is, the work was performed under conditions often the reverse of ideal. The Station itself during that period was very much in the development stage. The extreme " newness," in the agricultural sense, of much of the land on which of necessity the work had to be carried out, the necessity to train sub-staff in their elementary routine duties, and the initial lack of laboratory facilities were factors which militated against progress.

It is satisfactory, however, to record that many of these difficulties are now becoming, or have already become, things of the past. At the date of this report the Research Station is nearing completion. Land sufficient for all immediate requirements has been broken from veldt, and is rapidly being brought into good agricultural condition. The laboratory building has now been completed and the equipment installed, and for the first time proper facilities for the conduct of the work may be said to be available.

The recent history of cotton cultivation in Northern Rhodesia is one of a rapidly declining production. The acreage under the crop has fallen from 11,849 acres in 1925/26 to 172 acres in 1927/28, and in the present season the only cotton which has come forward for ginning

is that from the six external trial plots (for which small quantities of seed of U.4 bulk, grown for one season on the Station, were issued to the growers) referred to in Table III of Mr. Bebbington's report.

Growers in the Territory have learned that it is no use attempting further cotton cultivation with the old non jassid-resistant varieties of "Improved Bancroft," "Arizona" and "Watt's Long Staple," which they previously grew, and an urgent demand on their part for a jassid-resistant variety has now arisen. The provision of this is regarded as the most pressing problem which has to be faced.

The weight of evidence which has been collected so far indicates that Barberton U.4 gives distinct promise of being able to withstand local conditions, and efforts are accordingly being concentrated on the bulking of it up for issue should it continue to prove satisfactory, and on re-selecting the most desirable types from it—a procedure to which it appears to lend itself well.

From an importation of this seed (U.4) made from Barberton in 1928, sufficient seed was produced at the Station in the season under review to permit of 110 acres of this variety being grown in small trial plots at various places throughout the Territory in the coming season (1929/30). Should the variety continue to react satisfactorily, the produce of these plots will be available for further re-issue.

## RESEARCH STATION, MAZABUKA. REPORT ON WORK ON COTTON, SEASON 1928-29.

BY

A. G. BEBBINGTON AND W. ALLAN.

### Selections.

During the season 1927-28 some 212 single-plant selections were made. These were drawn from the following strains:—Barberton U.4, U.4/5, U.4/6, A.12, C.8, Z.1/9, Z.49/6, Z.106, B.134/4. Also Over the Top, Improved Bancroft, Foster Whitehall Cross and Arizona.

In the limited time available, and on account of lack of the necessary apparatus, it was impossible to do more than gin these plants and obtain a figure for their mean maximum lint lengths. Ginning was carried out by hand as no small roller gin was available. Although it was realised that the number of selections was far too large to be efficiently handled, it was not thought justifiable to discard any plants on the standard of the one measured characteristic.

Season 1928-29.

Planting was commenced on December 9th, but was then held up by heavy rain until the 13th, being finally completed on the 15th.

Three 50-yard rows of each selection were planted at a spacing of 3 ft. 6 ins. by 3 ft. 6 ins., giving 43 plants to the row. Every seventh row was planted with Durango, a jassid-susceptible type obtained from Gatooma, in order that a thorough exposure of the selections to jassid attack should be obtained.

A somewhat poor stand resulted from the first planting, due to caking of the surface soil consequent on heavy rain following planting. An excellent stand was obtained, however, from the later plantings. The plants grew away very well early in January, but were damaged to some extent by a violent rain storm accompanied by hail in the middle of the month. Growth was also further hindered by the heavy rains during the latter part of this month which caused a considerable amount of water-logging. During the remainder of the season growth was normal except that the plants made a large amount of vegetative growth which may be attributed to the heavy rainfall.

Early in March it was realised that, from the point of view of jassid resistance, the selections drawn from the Arizona, Foster Whitehall Cross, Over the Top and Improved Bancroft varieties were unsatisfactory. All were discarded later in the season.

The selections in A.12, Z.1/9, Z.49/6, Z.106 and C.8 showed very marked resistance to jassid attack but were heavily infested by aphis from the middle of February until early in May. Those drawn from U.4, U.4/5 and U4/6 showed a sufficient resistance to jassid and at the same time appeared to be infested by aphis to a less extent.

A preliminary selection of plants was carried out in late February and early March. Upwards of a thousand plants were selected. Piccanins were employed in selfing these plants throughout the flowering season, the flowers being tied by means of wool.

The selections from the Barberton Z cottons, also those from Andrews 12, Cambodia 8 and Barberton Bancroft 34/4 gave very poor yields and were all discarded. Small bulks of these will be carried on in the coming season for further observation.

The most promising selections were those drawn from Barberton U.4, U.4/5 and U.4/6, although the latter two did not appear so good as those taken from U.4 bulk.

Fifty-seven plants were re-selected from the U.4 bulk selections. These were examined for boll weight, seed weight, mean maximum lint length, ginning percentage, uniformity and yield. In the determination of boll weight, a sample of 10 average bolls was

employed, and a similar sample of 10 combed seeds was used for the measurement of lint length. On the basis of these characteristics 11 plants were discarded. The remainder show some very promising features, although the average of their yields is possibly somewhat low.

Figures for some of the more interesting plants are given in Table 1.

TABLE I.

| *Number.* | *1st Picking. Gms.* | *2nd Picking. Gms.* | *3rd Picking. Gms.* | *Total Yield. Gms.* | *Seed Cotton per Boll. Gms.* | *Lint Length. Mms.* | *Seed Weight. Gms.* | *Ginning Percentage.* |
|---|---|---|---|---|---|---|---|---|
| U4/M16/1 | 98·7 | 51·8 | 9·6 | 160·1 | 5·0 | 31·2 | 9·5 | 36·8 |
| U4/M21/3 | 82·7 | 33·7 | 31·8 | 148·2 | 5·1 | 33·1 | 9·8 | 37·3 |
| U4/M24/1 | 47·8 | 94·2 | 51·6 | 193·6 | 3·8 | 30·8 | 9·8 | 35·6 |
| U4/M24/2 | 78·6 | 38·8 | 37·5 | 154·9 | 4·4 | 30·6 | 8·1 | 37·5 |
| U4/M24/3 | 81·4 | 93·5 | 45·7 | 220·6 | 4·5 | 30·6 | 9·5 | 33·5 |
| U4/M148/2 | 85·7 | 35·9 | 18·9 | 140·5 | 4·3 | 30·8 | 8·1 | 36·6 |
| U4/M149/1 | 112·0 | 19·0 | 11·4 | 142·4 | 4·5 | 31·2 | 8·9 | 35·0 |
| U4/M149/3 | 111·3 | 16·7 | 10·0 | 138·0 | 4·8 | 32·9 | 9·4 | 38·0 |
| U4/M150/1 | 45·9 | 85·4 | 51·8 | 183·1 | 4·1 | 34·2 | 8·7 | 35·6 |
| U4/M150/2 | 49·0 | 101·3 | 45·5 | 195·8 | 5·0 | 32·8 | 8·1 | 37·7 |
| U4/M151/2 | 73·7 | 59·0 | 43·7 | 176·4 | 4·7 | 30·1 | 8·6 | 43·1 |
| U4/M152/1 | 96·8 | 24·7 | 17·5 | 139·0 | 3·9 | 29·6 | 8·7 | 32·2 |
| U4/M152/2 | 84·2 | 47·5 | 21·5 | 153·2 | 4·3 | 31·5 | 9·0 | 33·5 |
| U4/M153/1 | 70·6 | 56·7 | 21·2 | 148·5 | 4·5 | 30·5 | 8·6 | 36·4 |
| U4/M153/6 | 158·9 | 72·1 | 46·5 | 277·5 | 4·6 | 31·1 | 9·1 | 36·6 |
| U4/M158/1 | 105·4 | 61·8 | — | 167·2 | 4·6 | 33·6 | 8·7 | 34·2 |
| U4/M158/2 | 106·6 | 24·2 | — | 130·8 | 4·9 | 32·9 | 9·5 | 36·8 |
| U4/M163/1 | 110·5 | 76·4 | — | 186·9 | 5·1 | 32·3 | 11·4 | 35·2 |
| U4/M165/1 | 83·1 | 85·4 | — | 168·5 | 4·6 | 32·7 | 8·6 | 34·5 |
| U4/M165/2 | 110·3 | 50·9 | 22·2 | 183·4 | 4·5 | 32·0 | 9·1 | 34·4 |
| U4/M170/1 | 107·0 | 31·4 | 6·6 | 145·0 | 4·7 | 31·3 | 9·3 | 36·9 |
| U4/M173/1 | 73·9 | 77·8 | 65·9 | 217·6 | 4·8 | 29·4 | 8·2 | 38·2 |
| U4/M183/1 | 105·9 | 30·6 | 9·1 | 145·6 | 4·2 | 33·1 | 9·2 | 39·6 |
| Averages for 46 Plants ... | 85·9 | 42·9 | 17·3 | 146·1 | 4·4 | 31·2 | 8·7 | 36·6 |

Further re-selections to a total of 16 were made from Barberton U.4/5 and U.4/6, but the majority of the original selections were discarded in the field. Of these 16, four plants were rejected, all of which were drawn from U.4/5. New selections were made from U.4 bulk, U.4/4, U.4/5 and U.4/6, also from Barberton Z.1/9 and Barberton C.8. In all 79 fresh selections were made, of which 12 were discarded after laboratory examination.

None of these fresh selections showed a yielding capacity equal to that of the re-selections from U.4 bulk. This is attributed to the fact that most of the small bulks from which these plants were drawn suffered from the water-logged conditions prevailing early in the season.

A total of 125 single plants will be carried on in the coming season.

### Field Experiments.

A spacing experiment was carried out, the strain employed being U.4 bulk.

Nine spacings were adopted for trial, each variant being replicated four times. The plots were of one-twentieth of an acre each and were arranged in four blocks.

The spacings adopted were :—

| | | |
|---|---|---|
| 12 ins.×3 ft. | 18 ins.×3 ft. | 24 ins.×3 ft. |
| 12 ins.×3 ft. 6 ins. | 18 ins.×3 ft. 6 ins. | 24 ins.×3 ft. 6 ins. |
| 12 ins.×4 ft. | 18 ins.×4 ft. | 24 ins.×4 ft. |

This was planted on the 7th and 8th of December, and a stand of 80% was obtained. Unfortunately the soil was subject to considerable wash and water-logging.

The differences in yield due to variation in spacing were, in one block, completely overshadowed by the generally bad condition of the soil. In addition, three plots of another block were more or less completely destroyed by lightning. In consequence no results of any significance were obtained.

A time-of-planting experiment was also carried out. The strain used was again Barberton U.4 bulk, and the lay-out exactly similar to the previous experiment described. Eight weekly plantings from December 5th to January 31st were made, each planting being replicated four times. Similar conditions prevailed in this experiment with regard to the soil as in the spacing experiment. As a result the yield figures from one block were valueless. From the remaining replications it would appear that the three early plantings were considerably better than the remainder, but no results of any definite significance can be given.

### Multiplication Plots.

Small acreages of the following strains were grown for observation purposes and multiplication :—Barberton U.4/5 and U.4/6, Barberton Andrews 12, Barberton Cambodia 8, Barberton Z.1/9, Foster Whitehall Cross and Arizona. The yield figures are given in Table II (page 136).

It was not possible to carry out reliable flowering and bolling counts as the plots were scattered over a large area. These were, however, undertaken in order to train two native assistants for future work of this nature.

In every case these bulks appeared to be seriously affected by the heavy rainfall in January, which rendered cultivation impossible for the major part of that month in addition to causing wash and water-logging.

*Barberton U.*4/5.—This strain, as may be seen from its yield, did not give too favourable an impression. On comparison with the U.4 bulk and on the advice of Mr. Parnell this strain has been discontinued.

*Barberton U.*4/6.—The highest yield on the station was obtained from this strain, but it must be taken into consideration that the land on which it was planted was probably better than the average of the soils under cotton during the season. It showed a marked resistance to jassid, but at the same time appeared to be later maturing than U.4 bulk. It will be further multiplied during the coming season.

*Barberton Andrews* 12.—This strain gave most disappointing results, due principally to the unsuitable soil on which it was planted, as during January parts of the field were under water. Further, the plants were very heavily infested with aphis from mid-Febuary until the beginning of May. Growth was stunted and the plants very unhealthy. No selections were made in the strain, but a further small bulk will be grown for observation purposes.

*Barberton Cambodia* 8.—This was planted in the same field as the previous strain, but did not suffer to the same extent either from bad soil conditions or aphis. A considerable variation of types was found and a small number of selections were made.

*Barberton* Z.1/9.—This strain gave a remarkably even stand, and although growth was hindered, due to lack of cultivation and consequent weed growth in January, the plants came away rapidly in February. Aphis attacked the crop to some extent, but to a very much less degree than Andrews 12. Selections were made from this bulk and an observation plot will be carried on during the coming season.

*Arizona and Foster Whitehall Cross.*—Both were found to be completely unsatisfactory from the point of view of jassid resistance and were discarded.

*Barberton U.*4 *Bulk.*—Approximately 20 acres of this strain were planted for the purpose of multiplication with a view to a limited distribution of seed in 1929-30. The ground chosen was not altogether suitable, as it was inclined to be subject to wash in parts. Growth was very much hampered by the wet conditions and also by quite a severe attack of Angular Leaf Spot in January. Aphis also appeared on the plants to quite a large extent. The crop as a whole appeared to be sufficiently resistant to jassid under the conditions of the season, except in some patches where the plants were unhealthy due to wash and water-logging. During March a considerable number of the young bolls were found to be attacked by some form of boll rot, but this condition seemed to disappear after the cessation of the rains.

Samples of lint were submitted to the Central Co-operative Cotton Exchange Ltd. Mr. Hesse reported that " While the cotton is excellent in grade, being very clean and of very nice bright colour, the fact that staple is very short goes definitely against it ". The grade obtained was "Fifi," and the staple was one and one-sixteenth of an inch. This bulk undoubtedly contained some types which will be suitable for commercial cultivation, but considerable selection work will be necessary before a thoroughly suitable strain can be issued.

TABLE II.

| *Variety.* | *Acreage* | *Total Yield in Lbs.* | *Yield Seed Cotton per Acre in Lbs.* |
|---|---|---|---|
| B.U4/5 ... ... ... ... ... | 2 | 560 | 280 |
| B.U4/6 ... ... ... ... ... | 2 | 771 | 385 |
| B.A.12... ... ... ... ... ... | 3 | 244 | 81 |
| B.C.8 ... ... ... ... ... ... | 1 | 171 | 171 |
| B.Z1/9 ... ... ... ... ... | 2 | 553 | 276 |
| B.U4 ... ... ... ... ... ... | 20 | 6,547 | 327 |
| Arizona ... ... ... ... ... | 1 | 125 | 125 |
| Foster Whitehall Cross ... ... ... | 1 | 143 | 143 |

In addition, six small plots, of from 2 to 5 acres each, were grown by farmers for observation purposes. The farms were chosen by Mr. McEwen with regard to altitude, soil variation, and ease of access, the choice of the actual site of the plot left to the discretion of the farmer. The plots ranged from altitudes of 3,000 to 4,000 feet above sea level, and the soils from medium-heavy clay to light sandy loam. The results obtained from these plots were most disappointing and are given in Table III.

*Plot* 1.—The stand obtained was negligible and no crop of any consequence was reaped.

*Plot* 2.—This consisted of 2 acres planted on a medium-heavy clay at an altitude of roughly 3,000 feet above sea level. Growth was fairly satisfactory, but the plants suffered from lack of cultivation.

*Plot* 3.—This plot gave a striking example of the effect of increasingly adverse soil conditions on the growth of the plant. The cotton was planted in long rows running down a gentle slope. The soil showed a gradual transition from a red sandy loam at the top of the slope to a black heavy clay at the bottom. Growth was quite normal at the upper end and the plants were bearing well. They also showed good resistance to jassid attack. Proceeding down the slope, the plants became more and more unhealthy showing less resistance to jassid until the black clay soil was reached, where the average plant was no more than 6 inches high and carrying no crop.

*Plot* 4.—This plot was situated very close to the previous one, but better soil conditions existed. The stand obtained, however, was very poor, being estimated at no more than 30%. The plot was one of five acres, and considering the stand, the yield may be considered good.

*Plot* 5.—This plot was the most successful of all. It was situated at an altitude of approximately 4,000 feet above sea level on a medium sandy loam, being 5 acres in extent. An excellent stand was obtained and the plants grew away very well. Very little damage was suffered from jassid, aphis or stainers (*Dysdercus Spp*), all appearing to be present in smaller numbers than elsewhere. It is probable that an even better yield might have been obtained had the field not been given a dressing of kraal manure which caused a large amount of vegetative growth.

*Plot* 6.—This plot was situated on a farm just south of Broken Hill and only one opportunity of visiting it arose during the season.

The stand obtained was excellent, but the plants exhibited a tendency to excessive vegetative growth. Further, a considerable number of bolls were found to be rotted. The yield was not satisfactory.

TABLE III.

| *Plot.* | *Acreage.* | *Total Yield in Lbs.* | *Yield Seed Cotton per Acre in Lbs.* |
|---|---|---|---|
| No. 1 ... ... ... ... ... ... | 2 | No return | — |
| No. 2 ... ... ... ... ... ... | 2 | 300 | 150 |
| No. 3 ... ... ... ... ... ... | 2 | 458 | 229 |
| No. 4 ... ... ... ... ... ... | 5 | 599 | 120 |
| No. 5 ... ... ... ... ... ... | 5 | 1,168 | 233 |
| No. 6 ... ... ... ... ... ... | 5 | 476 | 95 |

## New Introductions.

A number of small plots of strains imported from Barberton, Gatooma, and Nyasaland, were grown during the season. These included :—From Barberton : Bancroft 179, Bancroft 180, and U.4/4 ; from Gatooma : Trice, Scott's Delfos, Gatooma Cambodia 8, Gatooma Cambodia 6A, Million Dollar, and an F.1 generation of an Egyptian × Cambodia Cross ; from Nyasaland : two strains of Foster Whitehall Cross and a strain of which the name was unknown.

Of these 12 strains all were discarded on account of susceptibility to jassid attack, with the exception of Bancroft 179 and 180, U.4/4, G.C.8 and G.C.6A. Small plots of these will be carried on for further observation.

## Cotton Pests.

### *I. Pests of Major Importance.*

*Jassid* (*Empoasca fascialis* Jacobi).—Adults were first observed in small numbers on the cotton plants on January 11th. Daily observations on the distribution of the adults throughout the fields suggested influx from the adjacent veld. After a heavy hail storm on the 13th of January, no jassids could be seen on the cotton plants, and it was found that they had taken shelter in an adjoining field of groundnuts.

Nymphs were first noticed on the leaves of Durango on January 15th and counts of nymphs on the leaves of this strain were commenced on January 17th. Counts on 13 other strains were commenced two days later. Until the 18th of February these counts were made on two leaves of 10 plants in each strain. Thereafter the number was increased to 10 leaves of 10 plants in each strain, and counts were made three times in each week. An effort was also made to give a numerical expression for the effect on the plant. The jassid work consisted mainly in the accumulation of data afforded by these counts. In the absence of laboratory facilities detailed work on the bionomics of the jassid was impossible, but an effort was made to find out something of the wild host plants of the insect. A common local species of *Thespesia* was suspected. Jassid nymphs from the *Thespesia* were taken and reared on cotton while jassid nymphs from cotton were reared on leaves of *Thespesia*, and their developmental period compared with that of nymphs from cotton reared normally on cotton. All completed their development from newly hatched nymph to adult in approximately the same period of 10–11 days. This work was carried out under somewhat primitive conditions, and the number of nymphs which could be reared was small.

Other wild host plants are suspected, and it is hoped to carry out further studies under more advantageous conditions in the coming season.

### *Bollworms.*

(*Diparopsis castanea* Hamps).—The Sudan bollworm has been recorded from North Eastern Rhodesia, and in 1925 was reported as not occurring in North Western Rhodesia.(1)

The writer's experience confirms the belief that it is not yet present in North-Western Rhodesia. All plots of cotton grown were examined for its presence, but no sign of the pest was observed.

*Chloridea obsoleta* F.—The American bollworm was first observed attacking squares early in February. It attained a maximum population during April and May. An undetermined species of Tachnid fly

was reared from the larva, but so far it has not been possible to estimate the degree of parasitism.

The pest attained considerable proportions and, should cotton growing become established, investigation of control measures will be desirable.

*Earias insulana* Boisd.—Spiny bollworm larvæ appeared on the squares in February. During March and April they were present in considerable numbers, but it is doubtful if the pest is to be regarded as a very serious one. A hymenopterous parasite of the larva apparently acted in some measure as a check.

*Cotton Stainers—Dysdercus sp.*

*Dysdercus fasciatus* Sign. was observed on the plants in February, but did not occur in any numbers until March.

*D. superstitiosus* F. and *D. intermedius* Dist. appeared somewhat later. *D. fasciatus* alone occurred in sufficient numbers to cause extensive staining.

A graph showing the seasonal distribution and relative numbers of these three species has been constructed from daily counts of individuals hand-picked from the plants and is reproduced (Fig. 1). The numbers of *D. fasciatus* were relatively so much greater than those of *D. intermedius* and *D. superstitiosus* that it was found necessary to construct the curve representing the distribution of that species on a scale ten times greater than that of the curves for the other two species.

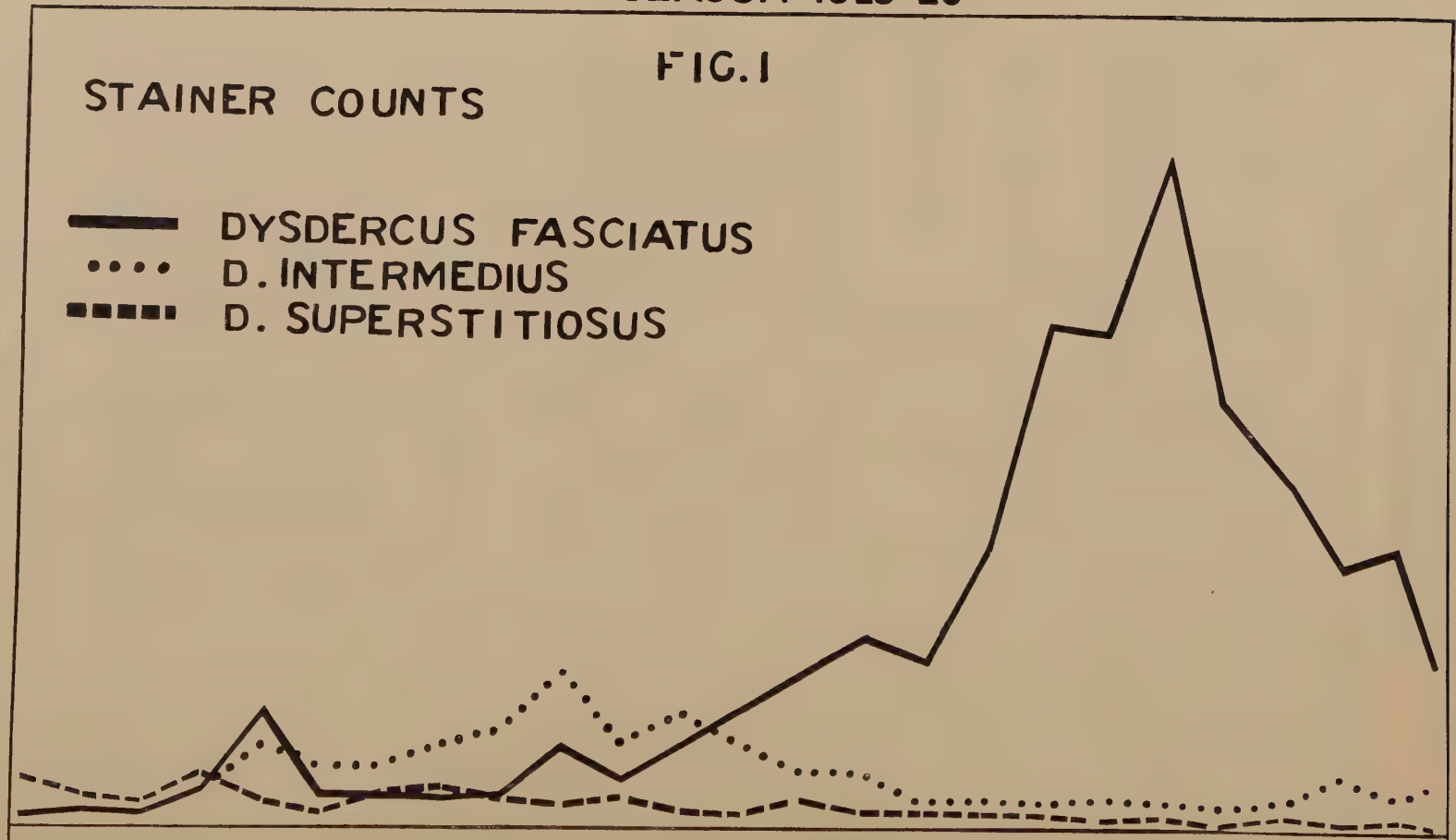
Investigations in controlling the attack of stainers by traps of crushed seed (*a*) placed on the ground in the normal way, and (*b*) placed on sheets of metal to act also as shelter traps, were carried out. Nineteen rows of cotton, covering an area of 0·8 of an acre, were treated with 70 traps, of which 35 were laid directly on the soil and 35 were laid on iron sheets 40 yards apart. Nineteen rows covering the same area were laid off at some distance for hand picking. The traps were kept moist and renewed once a week.

Number of Adult Stainers Taken in Two Forms of Seed Trap and by Hand Picking, 1929.

| *Month.* | *Traps on Metal.* | | *Traps on Ground.* | | *Hand Picking.* | | *Total Stainers.* |
|---|---|---|---|---|---|---|---|
| | *Females.* | *Males.* | *Females.* | *Males.* | *Females.* | *Males.* | |
| March ... ... | 63 | 104 | 88 | 101 | 34 | 31 | 421 |
| April ... ... | 184 | 200 | 256 | 283 | 351 | 353 | 1,627 |
| May ... ... | 437 | 513 | 274 | 367 | 629 | 607 | 2,827 |
| June ... ... | 798 | 1,089 | 620 | 751 | 2,252 | 2,543 | 8,053 |
| July ... ... | 2,358 | 2,598 | 1,666 | 2,032 | 3,768 | 4,743 | 17,165 |
| September ... | 2,447 | 3,387 | 1,078 | 1,656 | 369 | 627 | 9,564 |
| Total ... ... | 6,287 | 7,891 | 3,982 | 5,190 | 7,403 | 8,904 | 39,657 |

MAZABUKA AGRICULTURAL RESEARCH STATION
SEASON 1928-29

FIG. 1




140

The Reduviid *Phonoctonus principalis* Grst. occurred commonly on the cotton and was observed to attack a nymph of *Dysdercus*.

### II. *Pests liable to become Major Pests.*

*Aphis gossypii* Glov. Aphis attack commenced early, the pest making itself obvious late in December and establishing strong colonies in January. Heavy rains in January checked the aphis, but on the cessation of the rains it multiplied rapidly and established a firm hold on the plants. The normal natural enemies of the aphis did not appear until the colonies were firmly established. Syrphid larvae (*Syrphus sp.*) were observed preying actively on the aphis at the end of January and the first coccinellid larvae (*Chilomenes lunata* F.) were seen early in February. Lacewing flies and their larvae (*Chrysopa sp.*) were seen early in March by which time the coccinellid was numerous. It is somewhat remarkable that in spite of careful search only one species of coccinellid (*Chilomenes lunata*) was observed preying on the aphis.

An observation of some interest may be recorded here. The Pentatomid (*Glypsus conspicuus* Wstw.) is recorded in the Union of South Africa as a natural enemy of the Sudan bollworm (²). This Pentatomid occurred in considerable numbers on cotton at Mazabuka, and so far as the writer's observations went preyed entirely on the larvae of the Syrphid fly, on the reproduction of which it probably acted as a check. An attempt was made to express the intensity of aphis attack on the various strains of cotton by means of symbols which could be expressed numerically and plotted on the jassid graphs (Figs. 2 and 3).

There seemed to be some indication that jassid-resistant strains are more susceptible to aphis, but the results of one season are not sufficiently conclusive to warrant a definite statement.

### III. *Minor Pests.*

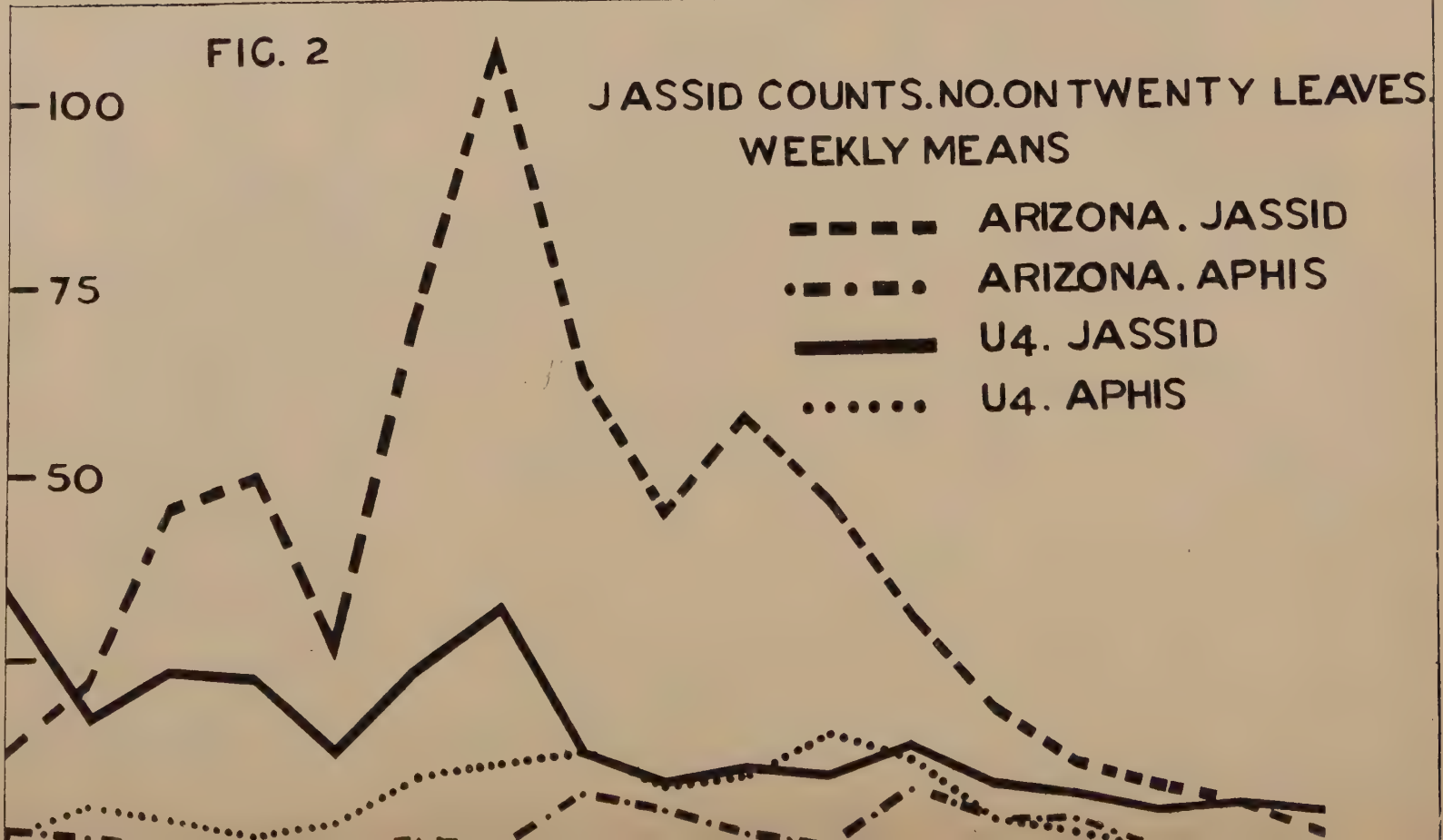
*Plant Suckers.*

1. *Callidea dregei* Germ. This Pentatomid occurred in considerable numbers on cotton and on *Hibiscus cannabinus* throughout the season. It may be associated with the spread of internal bollrot.

2. *Agonoscelis puberula* St. The Pentatomid *Agonoscelis puberula* infested one plot of cotton in large numbers. The insects clustered at the base of the young shoots and the attack resulted in the wilting of these shoots. A similar species (*A. versicolor*) is recorded attacking cotton in Tanganyika Territory (³).

Other minor pests were observed, but there is nothing special to record concerning them.

MAZABUKA AGRICULTURAL RESEARCH STATION
SEASON 1928-29



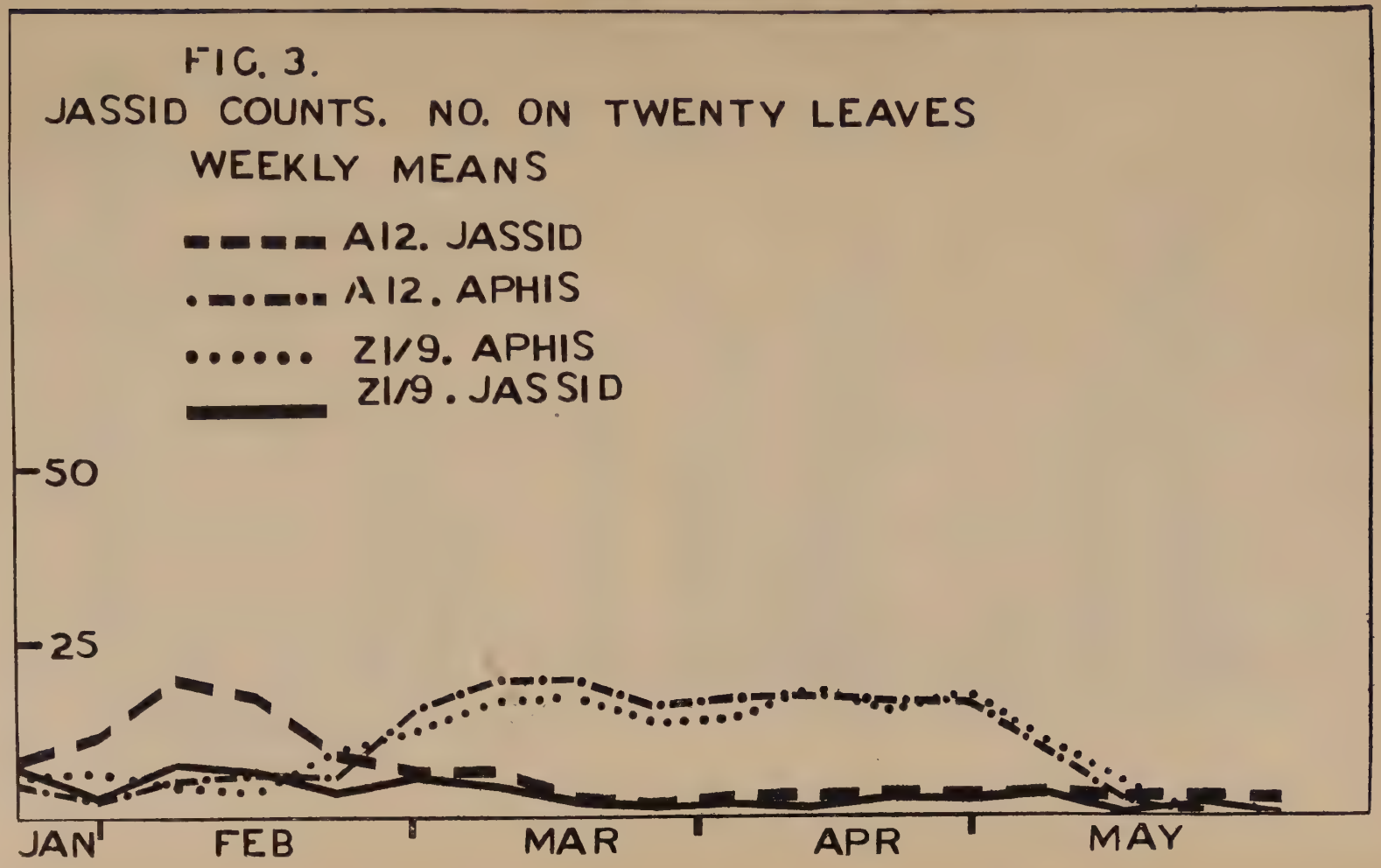


FIG. 3.
JASSID COUNTS. NO. ON TWENTY LEAVES
WEEKLY MEANS
A12. JASSID
A12. APHIS
Z1/9. APHIS
Z1/9. JASSID
50
25
JAN
FEB
MAR
APR
MAY

### General.

A Dobson and Barlow 12-inch roller gin was obtained during the year. Also the loan of a Platt 40-saw gin was obtained from the Northern Rhodesian Cotton Co-operative Society, to whom the writers are indebted for their interest and assistance during the season.

A successful open day for farmers was held on April 10th. General satisfaction was expressed at the appearance of the jassid-resistant strains obtained from Barberton.

During the year the Station was visited by His Excellency the Governor, Sir James Maxwell; the Honourable John Smith, Acting Secretary for Agriculture; Mr. Milligan; Major Walter Elliott, M.P.; Mr. Wilmot, of the Anglo-American Corporation; Professor Burtt Davy, and other members of the British Association.

### References.

1. King: Notes on the Red (Sudan) Bollworm (*Diparopsis castanea*) in Nyasaland, *Empire Cotton Growing Review*, Vol. III, No. 4.
2. Union of South Africa: Department of Agriculture Entomological Notes. Series No. 39.
3. Ritchie: Rep. Department of Agriculture, Tanganyika Territory, 1924–25, p. 44.

### Mazabuka Research Station.

### Daily Rainfall.

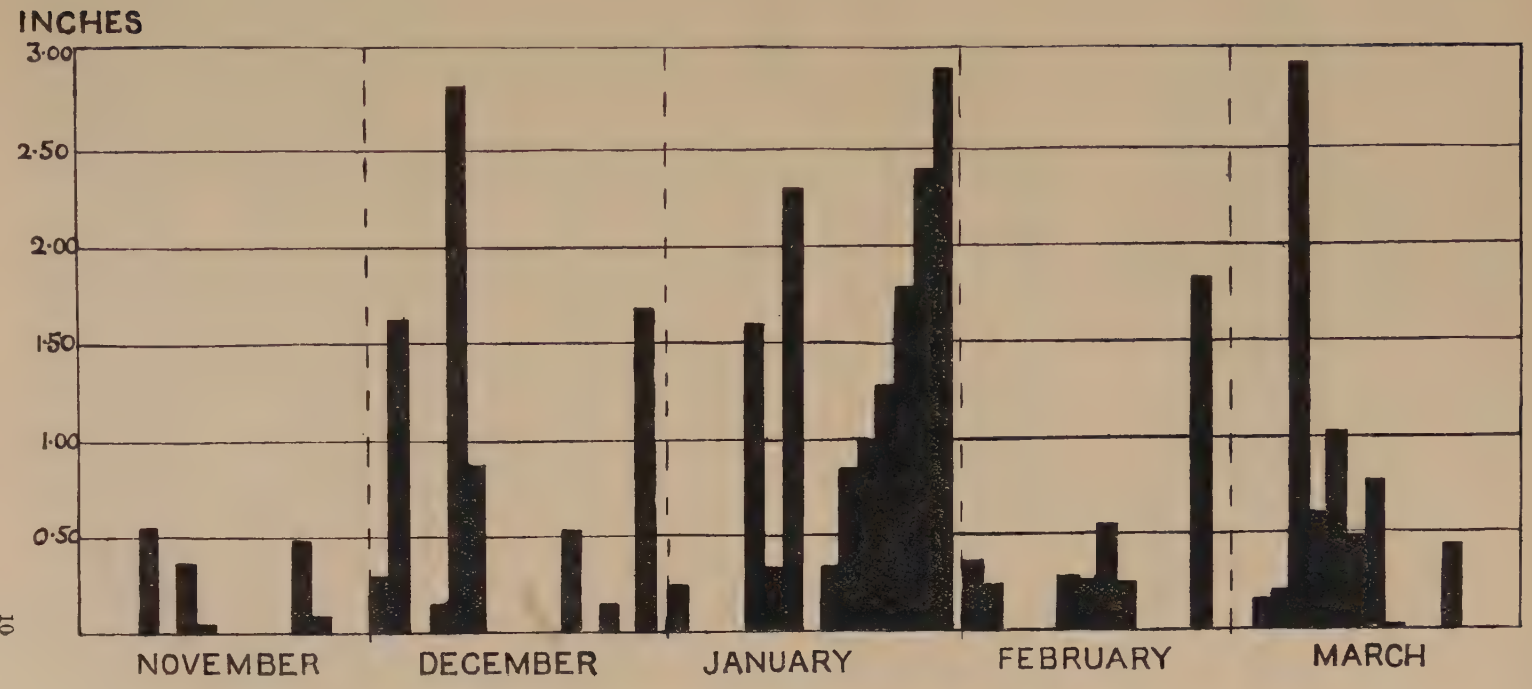
Season 1928–29.

| | *July.* | *Aug.* | *Sept.* | *Oct.* | *Nov.* | *Dec.* | *Jan.* | *Feb.* | *Mar.* | *Apr.* | *May.* | *June.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 ... ... | — | — | — | — | — | 0·27 | 0·08 | 0·03 | — | — | — | — |
| 2 ... ... | — | — | — | — | — | 0·02 | 0·15 | 0·33 | — | — | — | — |
| 3 ... ... | — | — | — | — | — | 1·62 | — | 0·24 | — | — | — | — |
| 4 ... ... | Tr. | — | — | — | — | — | — | — | 0·16 | — | — | — |
| 5 ... ... | — | — | — | — | — | Tr. | — | — | 0·11 | — | — | — |
| 6 ... ... | — | — | — | — | — | — | — | — | 0·09 | — | — | — |
| 7 ... ... | — | — | — | — | 0·53 | — | — | — | 2·33 | Tr. | — | — |
| 8 ... ... | — | — | — | — | 0·01 | 0·15 | — | — | 0·62 | — | — | — |
| 9 ... ... | — | — | — | — | Tr. | 2·62 | — | — | 0·47 | — | — | — |
| 10 ... ... | — | — | — | — | — | 0·20 | 1·60 | — | 0·14 | — | — | — |
| 11 ... ... | — | — | — | — | 0·37 | 0·86 | 0·32 | 0·12 | 0·11 | — | — | — |
| 12 ... ... | — | — | — | — | — | Tr. | — | 0·16 | 0·92 | — | — | — |
| 13 ... ... | — | — | — | — | 0·04 | — | 2·24 | — | 0·47 | — | — | — |
| 14 ... ... | — | — | — | — | — | — | 0·06 | 0·26 | 0·02 | — | — | — |
| 15 ... ... | — | — | — | — | — | — | Tr. | 0·55 | — | — | — | — |
| 16 ... ... | — | — | — | — | — | — | — | — | 0·78 | — | — | — |
| 17 ... ... | — | — | Tr. | — | — | — | — | 0·24 | — | — | — | — |
| 18 ... ... | — | — | — | Tr. | — | — | 0·32 | — | 0·01 | — | — | — |
| 19 ... ... | — | — | — | — | — | — | — | — | Tr. | — | — | — |
| 20 ... ... | — | — | — | — | — | — | 0·84 | — | Tr. | — | — | — |
| 21 ... ... | — | — | — | — | — | 0·53 | 0·04 | — | Tr. | — | — | — |
| 22 ... ... | — | — | — | — | Tr. | — | 0·94 | — | Tr. | — | — | — |
| 23 ... ... | — | — | — | — | 0·06 | — | 0·44 | — | 0·44 | — | — | — |
| 24 ... ... | — | — | — | — | 0·43 | — | 0·84 | — | Tr. | — | — | — |
| 25 ... ... | — | — | — | — | Tr. | 0·14 | 0·72 | 0·24 | — | — | — | — |
| 26 ... ... | — | — | — | — | 0·09 | — | 1·06 | 1·60 | — | — | — | — |
| 27 ... ... | — | — | — | — | — | — | 1·06 | — | — | — | — | — |
| 28 ... ... | — | — | — | — | Tr. | Tr. | 1·34 | — | — | — | — | — |
| 29 ... ... | — | — | — | — | — | 1·12 | 1·13 | — | — | — | — | — |
| 30 ... ... | — | — | — | — | — | 0·55 | 1·78 | — | — | — | — | — |
| 31 ... ... | — | — | — | — | — | — | — | — | — | — | — | — |
| Totals ... | — | — | — | — | 1,53 | 8·08 | 14·96 | 3·77 | 6·67 | — | — | — |

Total Rainfall for year = 35·01 inches.

# RAINFALL-MAZABUKA, 1928-29

IN (2-DAY TOTALS)



# ANGLO-EGYPTIAN SUDAN

## REPORT ON THE WORK ON COTTON CARRIED OUT BY THE PLANT BREEDING SECTION, DEPARTMENT OF AGRICULTURE AND FORESTS, SEASON 1928-29*

BY

M. A. BAILEY.

### Part I.—Summary.

Breeding work at the Experimental Farm at Shambat was adversely affected by the low yields obtained this season. This drop in yield compared with last season was presumably partly, at any rate, seasonal, as six out of eight of the Government Pump Stations north of Khartoum showed a notable decline in yield compared with last season (see p. 149).

The crop at the Experimental Farm made a strong effort towards recovery during December and January, but the bolls then produced were for the most part rendered useless by a very severe boll worm infestation, which set in at the end of the season.

Leaf Curl disease spread to a serious extent during the season at Shambat. The Sea Island types, which are being used for hybridization purposes, were particularly affected, and it is much to be regretted that the hybrid derivatives so far obtained from them appear also to be specially susceptible (p. 152). This has rendered necessary the scrapping of much promising material. A large number of new selections have been made from amongst Sakel plants with the sole object of obtaining resistant strains. There appear to be many more resistant types amongst American cottons than amongst Sea Island and Egyptian varieties, and interesting indications have been obtained of a connection between Jassid resistance and immunity from Leaf Curl disease (p. 154). Some of the native Sudanese types also appear to be highly resistant, and use is being made of this fact in hybridization work (p. 153). A list is given on pp. 155 and 156 of the more promising types at present coming on in the breeding plots.

A considerable number of types are now in various stages of propagation (p. 156). A block of 40 feddans is being sown in the coming season at Mikeilab of a strain of Delta Webber cotton to which the

* May 1st, 1928, to April 30th, 1929.

name " Delrect " has been given in allusion to its relatively upright habit of growth. This is the product of a single plant selection, and gave very promising results at Shendi in the season just past.

Other interesting American cottons grown in small propagation plots included two from the Serere Station in Uganda and four of Mr. Parnell's jassid-resistant types. The latter appeared to show resistance to Leaf Curl disease.

A start is being made with the propagation of a relatively pure substrain of " Sakel 186," which has given very satisfactory results in the standard variety tests conducted in the Gezira in the last three years (p. 158).

A detailed report on the results of Variety Tests in the past season is given on pp. 159 to 181, including a list of test-station localities on pp. 159 and 160. The method of "Analysis of variance" has been adopted in working up the data and is used in conjunction with the method of " probable correction " previously devised.

Sakel 186 and Sakel B/24 were the two most successful in the Gezira tests this year, and Sakel 186 appears to have done best over a period covering the last three years during which time it has been tested against " Main Crop " Sakel.

Results from the American Standard Variety Tests confirm those previously obtained from plots grown under irrigation (p. 170), but are at variance with those obtained in rain-grown areas (p. 175).

Detailed figures for ginning out-turn are available for these plots for the first time, and show very interesting " climate " and " place " effects (p. 178). Low ginning out-turn appears to be associated with deficient soil moisture, but the varieties tend to maintain their relative position with considerable closeness, under the different conditions (p. 179).

The results of Grader's and Spinning Tests on the 1927–28 crop are now to hand and are summarised on pp. 182 to 189.

Developmental observations on cotton plants have led to several interesting results. It has been found that the suppression of fruiting branches under conditions of excessively high temperature is due to their actual conversion into vegetative branches which usually remain in a partly developed condition; these we have described as " monopodial tufts " (p. 190).

Root studies have been continued. A fresh variety, Tanguis, has been studied, in view of its strong aerial growth. Direct information has been obtained as to the comparative fertility of the different layers of soil, by growing plants in boxes made up from soil taken from successive depths (p. 191).

Bud shedding records have given interesting results, and bud shedding has been shown to be the major factor in determining the low yields at Shambat in the present season (p. 193). Most of the bud shedding takes place at a relatively early stage (bracteoles 0·8 mm. in diameter), and its effects are visible in diminished flowering about two weeks later. Excessively low humidities were probably largely accountable for the high rate of bud shedding.

Our observations indicate that the "blind seeds," which are sometimes found in quantity mixed with the ginned lint, owe their origin to lack of water and not to lack of insects capable of effecting cross fertilization (p. 194).

The shrinkage of bolls noted in a previous report has been confirmed, and information as to the prevalence of this phenomenon and the time and degree of its occurrence obtained (p. 195).

Buds and flowers were treated in various ways in order to ascertain the effect on the setting of seeds. It was found that amputation of a stigma lobe only slightly diminished the percentage of seeds which were set in the corresponding locule (p. 196).

In connection with studies made on defective boll-opening, indications were obtained that bolls shaded from direct overhead sunlight opened better than those which were not so shaded.

## Part II.—Introductory.

### Staff.

Mr. Ross arrived in December, 1928, to take up the duties of the post of Record Clerk, vacated by Mr. Howard owing to ill health.

No additions were made to the cadre of the Section, but certain exchanges were effected in the personnel occupying the more junior posts.

### Buildings.

Approval has been obtained for the erection of a cotton mixing room and of two additional living quarters during the coming season.

### Experimental Farm.

An area of three feddans situated in the midst of the adjoining forage farm has been taken over permanently, as an isolated plot for the breeding and propagation of American varieties.

Including this, the areas under different crops during the past season were as follows :—

| | | |
|---|---|---|
| Cotton... ... ... ... ... ... ... | 20½ | feddans. |
| Dura and Maize ... ... ... ... ... | 3 | ,, |
| Berseem ... ... ... ... ... ... | 10 | ,, |
| Lubia, etc. ... ... ... ... ... ... | 5 | ,, |
| Wheat... ... ... ... ... ... ... | 2 | ,, |
| Castor Oil ... ... ... ... ... ... | 1½ | ,, |
| Miscellaneous... ... ... ... ... ... | 1 | ,, |
| Fallow... ... ... ... ... ... ... | 29 | ,, |
| Trees, etc. ... ... ... ... ... ... | 20 | ,, |
| | 92 | feddans. |

As in previous seasons, two further areas of five feddans each have been worked with labour, etc., from the Experimental Farm. These areas were situated on the Shambat Pump Scheme and on the estate of Mr. Aziz Kfouri, and were used for cotton variety testing.

## General.

Disappointingly low yields have been obtained from the Shambat farm in general during the past season. The effect was particularly bad in the case of the breeding plots.

The probable causes of this drop in yields compared with the previous season, and the effect on available supplies of seed are discussed in the sections of the Report which relate to breeding and developmental observations.

Six out of eight of the Government Pump Stations north of Khartoum showed a corresponding drop in yield as shown in the following table :—

Yield at Pump Stations in Last Three Seasons Compared.
(Yields given in Large Kantars per feddan.)

| | 1926–27. | 1927–28. | 1928–29. |
|---|---|---|---|
| Shambat (Sakel Cotton)... ... ... | 1·1 | 2·6 | 2·0 |
| Gendettu (American Cotton) ... ... | 2·6 | 1·8 | 3·8 |
| Kitiab ,, ,, ... ... | 3·3 | 2·9 | 2·6 |
| Mikeilab ,, ,, ... ... | 3·3 | 3·3 | 4.1 |
| Bouga ,, ,, ... ... | 2·1 | 3·6 | 1·9 |
| Nuri ,, ,, ... ... | 3·8 | 4·1 | 3·4 |
| Gureir ,, ,, ... ... | 3·2 | 4·6 | 2·3 |
| Ghaba ,, ,, ... ... | 1·5 | 3·9 | 1·5 |

As regards climate, the two most important features of the season from the point of view of the cotton plant were (i) a very hot September (hottest day 45° C. ; 8 days above 42° C., and only 9 days below 40° C.). The temperatures were quite sufficient to cause a partial inhibition of fruiting branch production. (ii) Very subnormal humidity throughout practically the whole season, but especially so in September, October, November and in February and March.

The climatic conditions for the season are summarized in more detail in the accompanying table. Rainfall was very deficient.

| | *Maximum Temperature.* | *Minimum Temperature.* | *Relative Humidity.* |
|---|---|---|---|
| 1928. July ... | Above normal throughout last 3 weeks (about 3° C. on average). Temperature all 40°-43° during 2 middle weeks. | About 1° or 2° above normal throughout. | About normal as a whole, but rather subnormal during 2nd week. (Rainfall 14·7 mm.) |
| August ... | Almost all above normal (about 1° or 2°) but only 3 days above 40° C. | About normal. | About normal (round about 65 %.) (Rainfall 34·5 mm.) |
| September | All above normal; often very hot. Only 9 days below 40°. Maximum 45° C. in middle of month and 8 days over 42° C. | Slightly above normal. | All below normal (about 50 % instead of 60 %). (Rainfall—few drops.) |
| October... | All above normal, except for 3 days at end of first week. Rarely over 41°C. | About normal. | Much subnormal (about 35 % instead of 47 %). Very brief damper spells about 7th & 20th. (Rainfall—few drops.) |
| November | Variable, but normal on average hot spell for 10 days following 9th, but never reached 40° C. | Rather subnormal. | Whole month below normal — average about 35 % instead of 40 %. |
| December | All above normal by about 3° except for a really cold spell from 8th–11th. | About normal except during 8th–11th, when temperature ranged between 9° and 11° C. | First week rather subnormal — afterwards normal (about 50 %). |
| 1929. January... | Normal on average, but very variable. | About normal. | Rather subnormal. |
| February | First week below normal, as also 2 days just at end of month. Otherwise much above normal (about 4° on an average) and reached 43°C. on 18th | Variations followed those of maximum temperature. 3 cold nights (about 10° C.) from 2nd to 5th. | About 7 to 10 % below normal. (Actual average about 35 %). |
| March ... | Distinctly above normal for first 10 days (reached 42° C. twice). Otherwise about normal. | Above normal for first 10 days, otherwise subnormal. | Much below normal, except between 20th & 25th, when high. (Average about 30 %.) |
| April ... | Above normal and often very hot, except for remarkably cool spell from 21st–26th. | Variations followed those of maximum termperature. | Irregular, but mostly subnormal, except for one or two days when quite high. |

The flowering curve in the Observation plot commenced to rise at the same time as last year, but reached only half the height then attained. This was probably due partly to partial inhibition of fruiting branches brought about by high temperatures in September and partly to very heavy bud shedding corresponding to periods of low humidity in September, October and early November.

## Part III.—Experimental Work, Etc.

### 1. Selection, Line Breeding and Hybridization.

The methods used have been described previously in the Reports for 1925–26 and 1926–27, and need not be recapitulated here.

Altogether 313 single-plant families were grown. Records were made on all these in the field and a considerable number were carried on through the various stages of laboratory examination.

These families were grouped together as follows for purposes of convenience :—

| | |
|---|---|
| (*a*) *American* "*N.S.*" *plot* (New Selections), containing the progenies of plants which had been newly selected from bulk crops or which had stood out in last year's breeding plots as desirable off-type plants. | 69 families. |
| (*b*) *American* "*P.L.*" *plot* (Pedigree Lines), containing the progeny of plants which had come from pure or approximately pure stock of known pedigree. | 40 families. |
| (*c*) *Egyptian & Sea Island* "*N.S.*" *plot* (a few other related types, *e.g.*, Pima and Tanguis, were included here for convenience). | 61 families. |
| (*d*) *Egyptian & Sea Island* "*P.L.*" *plot* ... ... ... ... | 47 families. |
| (*e*) *Hybrid plot*, containing single-plant families in various stages (down to the 6th generation) in the fixation of desirable types derived from Sakel by Sea Island or Ashmouni by Sea Island crosses. | 44 families. |
| (*f*) *Reference plot.* A collection of small families (single lines) representing all the important types in use elsewhere in the Breeding plots, and, in addition, the local African types and examples of many Asiatic species, etc. | 52 families. |

From these 313 families, 913 selected plants were picked separately for examination in the laboratory, and a supply of self-bred seed was obtained from a proportion of the plants in practically all cases.

The modified method of selfing by the employment of small conical bags which are pulled over the buds and closed at the base with aluminium wire, which had been devised in the previous season, was used again in the present season and gave excellent results. A total of 13,500 flowers were selfed in the Breeding plots alone during the season, in addition to the very large number dealt with in the Propagation plots. It is perhaps worth recording that the grand total of 60,000 flowers (Breeding and Propagation plots) was accomplished by a squad of trained boys averaging eight in number, whose time is fully

occupied during the rest of the year on routine combing and other work in connection with the examination of single plants, and in sowing, thinning, picking and other work requiring special attention in the Breeding plots and Variety Test plots.

In general, the results obtained from the Breeding plots this year have been extremely disappointing, as compared with the very promising performance which was put up in 1927–28. Sown within three or four days of the same calendar dates, the average yield per plant in the present season was rather less than one-half in the case of the American Breeding plots, and, in the case of the Egyptian and Sea Island and Hybrid plots from less than one-half to only one-third of that which was obtained last year.

The causes of this low yield are discussed elsewhere in this Report, but a special note is necessary here in connection with Leaf Curl disease, which appears to be a virus disease similar to or identical with that described in Nigeria and elsewhere. The incidence of this disease appeared to be particularly heavy on all the pure Sea Island types and on most of their hybrid derivatives—Sakel × Sea Island and Upper Egyptian × Sea Island. In these the disease was sometimes sufficiently severe to bring about an actual necrosis of the top half of the main stem. Many bolls must have been lost directly in this way, and it is probable that the tendency to defective boll opening, which has already been noted as characteristic of these forms, was accentuated by the presence of this disease, as also by the heavy boll worm infestation which occurred at the same time.

The apparent hyper-susceptibility of these hybrid Sea Island types to Leaf Curl is especially regrettable as it would seem to necessitate an almost wholesale scrapping of what has hitherto seemed to be a most promising range of long-stapled cottons, with which it had been hoped to replace the Sakel now being grown, with consequent improvement in length and quality of staple as well as in the matter of yield and heat resistance. It is just possible, however, that one or two of the Sakel-Sea Island hybrid derivatives may be sufficiently resistant for the purpose.

Careful notes were made at the end of the season on the incidence of Leaf Curl disease in every family in the Breeding plots, and this close examination has brought out some interesting facts.

In the first place, there appear to be many more resistant types amongst American cottons than amongst Egyptian or Sea Island types—though this observation may be the result of the more tardy spread of the disease amongst the former, which were in a position isolated from the general cotton crop around. In the case of the

Egyptian types, Ashmouni and Afifi are possibly very slightly more resistant than Sakel—though this needs confirmation and, in any case, the difference is so small as to be of no practical value. Sea Islands as a class are the most susceptible of any of the kinds grown, though individual families of other varieties are sometimes equally bad.

Certain families and plants in the Sea Island and hybrid Sea Island plots showed much less heavy infestation than others. This may have been purely accidental, due to the irregular spread of the disease, but has been taken into account in making selections for the coming season.

Observations on the same lines made on plants in the " Reference Plot " gave clear indications that the local wild or semi-cultivated cottons are highly resistant and a similar resistance was noted in the Indian types.

The local types in this plot included the following :—(*a*) A dark red tree-cotton from the Nuba mountains, which appears to be type Arboreum, except for the number of glands on the leaf veins which is three instead of one ; (*b*) " Abu Hareira," a tree-cotton with yellow flowers with strong, dark-red spot, green leaves and heavily sunburnt stems. This type appears to correspond most closely with G. Nanking var. except in the matter of leaf shape, which is typical obtusifolium ; (*c*) " Belwa," a small bushy type with bronzy stems showing affinities with G. purpurascens and G. Mexicanum.

Of the above, the two first are clearly " Asiatic " types, and, as such, closely related to the Indian forms, with which they have been successfully crossed. The last named belongs to the " New World " Group as indicated by its characteristics and by the fact that we have been able to cross it on to an Egyptian-type cotton. If the apparent partial immunity of " Belwa " proves to be a fact, it is possible that the cross referred to above and others of similar nature may lead to the production of resistant strains of useful quality. (" Belwa " in its present form has very inferior lint.)

The American Upland types in the same plot gave some distinctly interesting results in the matter of resistance to Leaf Curl. Some of these were badly attacked and others only slightly affected ; the worst in this respect was Durango, and it is of interest in this connection to note that Durango has been shown in South Africa to be particularly susceptible to jassid attack. On the other hand, a family of Cambodia cotton grown just alongside was doubtfully, if at all, attacked (except for one plant which showed indications of being the result of an out-cross). Cambodia has been shown in South Africa to be resistant to jassid.

In view of the supposed—but not yet proved—connection between jassids and Leaf Curl disease—the former being looked upon as likely transmitters—the above results are interesting and lend support to the theory. This is further borne out by the fact that four small plots of Parnell's jassid-resistant cottons (U.4, A.12, Z.1 and B.179) grown here in another field from seed supplied by Mr. Parnell, also showed resistance to Leaf Curl, as compared with the majority of American types near to them.

Direct damage by jassids in this country is not usually a matter of importance, but if the fact is established that they are instrumental in spreading the disease, the importance of growing jassid-resistant strains becomes obvious.

Workers in South Africa have claimed a connection between hairiness of the leaves and stems and jassid resistance. In the cases just described the relationship was found to hold, and it also appeared to be exemplified in Tanguis cotton (imported from Peru), where three separate families were grown, the plants of which were "very woolly," "downy" and "almost glabrous." Here the severity of Leaf Curl disease appeared to vary directly with the degree of hairiness, but on the other hand, the most woolly strain of Tanguis was itself more severely attacked than neighbouring Sakel plants which are nearly glabrous. A similar state of affairs to this last was noticed also in the American Breeding plots, where more hairy types were sometimes more heavily attacked than their less hairy neighbours.

If the jassid be eventually proved to be the intermediary, it would seem that jassid-immunity may not be fundamentally dependent on hairiness, though influenced by it within limits, or, on the other hand, it may be that the final degree of infection with Leaf Curl may depend partly on the presence of a sufficient number of jassids on the plant and partly on a separate and distinct immunity of the plant from Leaf Curl, the two factors operating independently.

The selections made for carrying on in the Breeding plots in the coming season are as follows :—

| | | |
|---|---|---|
| American N.S. plot ... ... ... ... | 44 | selections. |
| „ P.L. „ ... ... ... ... | 41 | „ |
| Egyptian-type N.S. plot ... ... ... ... | 61 | „ |
| „ „ P.L. „ ... ... ... ... | 20 | „ |
| Hybrid Derivatives ... ... ... ... | 36 | „ |

Amongst the American types, the following appear to be the most promising :—

(*a*) A selection made from Meade, which is now breeding true for a number of characters. It differs markedly from Meade type in being

early, more fruitful, and in having lint of not more than $1\frac{3}{16}$th inch staple and a high ginning out-turn.

(*b*) Several selections from Delta Webber, embodying either erectness of habit, extra lint length, or both.

(*c*) Several selections from Colombia, including one strain which has very little resemblance to the original, and which is particularly erect, early, and fruitful, with lint of over $1\frac{1}{4}$ inch staple.

(*d*) A selected strain of Pedigree Dixie, which combines the normally vigorous habit of that plant with earliness, erectness, and long fine lint.

The outlook is not nearly so satisfactory in the case of long-staple Egyptian-type cottons, owing to the hyper-susceptibility to Leaf Curl disease of several of the most promising types as described above. The selections for the coming season are largely based on evidence of resistance to this disease. Apart from this, however, two interesting new types are being pushed forward. These are :—

(*a*) Cottons of full Sakel length on plants of Upper Egyptian habit. These are similar to and arose from the same original stock as the "Long Staple Uppers" type now being propagated in Egypt.

(*b*) Two selections from a stock of Afifi cotton which had been preserved in this country. These selected strains retain to some extent the vigour and earliness of Afifi, but their lint is of totally different character, usually creamy in colour and with staple longer than that of Sakel.

Both these types appeared to be only slightly susceptible to Leaf Curl, and one of them showed exceptionally strong growth and resistance to climatic conditions. They are neither, however, sufficiently pure as yet to allow of propagating-up into bulk.

In the "Hybrid plot," interest centres in the coming year on a few types which gave indication of a partial immunity to Leaf Curl, and on three newly made crosses, viz. :—

(*a*) *Sea Island* × *Afifi*, in which it is hoped to combine the vegetative vigour of both parents with something of the quality of the first and the earliness and clean-opening of the second parent.

(*b*) *Tanguis* × *Sea Island.*—Tanguis is a type which has shown itself capable of producing strong aerial and subterranean growth under conditions which affect adversely both Sakel and Upper Egyptian types. The lint, however, is not of satisfactory length or quality, and it is hoped in the present cross to obtain types which will be satisfactory in this respect.

(*c*) *Sakel-Sea Island Cross* × *Belwa.*—The chief interest in this cross lies in the hyper-susceptibility to Leaf Curl of the first parent

and the comparative immunity of the second. Useful resistant types may possibly be obtained in later generations.

In addition to all the selections enumerated above, a further 175 single-plant families will be grown from plants newly selected in the Sakel fields of the Gezira as showing a desirable degree of resistance to Leaf Curl. These selections will be treated separately from the general Breeding plot work and the seed from them will be sown in lines in a separate field, with intervening lines of specially susceptible Sea Island types to ensure as far as possible an even distribution of the disease throughout the field.

The " Reference Plot " will be carried on as in previous seasons and studies made of the types therein both botanically and genetically, with special reference to their freedom from or susceptibility to Leaf Curl disease.

## 2. Propagation.

The types propagated were as shown in the following list :— Delrect No. 1 was grown on a plot on the forage farm at Shendi, and Massey's Selected Domains Sakel on the Shambat Pump Scheme (including a roguing plot of 20 feddans) ; otherwise all the different kinds were raised on the Experimental Farm at Shambat.

*American types :—*

Delrect No. 1.
Delta Webber No. 6.
Uganda American S.G. 15.
„ „ S.G. 26.
Wild's No. 1.
Webber No. 10.
Columbia No. 40.
„ No. 43.
„ No. 44.
Meade (E.C.G.C.).
Webber No. 38.
Parnell's Jassid Resistant A.12.
„ „ „ B. 179.
„ „ „ Z. 1.
„ „ „ U. 4.

*Egyptian and related types :—*

Massey's Selected Domains Sakel.
Sakel 186/24.
Bolland Sakel 8.
Bolland Sakel 19.3.
Garofallou.
Shambur Sakel II.
„ „ III.
„ „ IV.
S.I.A. 2.7.
S.I.D. 1.8.
S.I.D. 3.2.
S.I.D. 14.1.

Of the above only a few types need special notice at the present time.

*Delrect No.* 1 is the result of a single plant selection made amongst many others in 1925 from a small plot of Coker's Delta Webber No. 1, which had been introduced into this country by Mr. Massey in 1924.

Observations made in 1925 showed that the Delta Webber type combined particularly good lint quality with a very satisfactory degree of earliness. It was for these reasons picked out from amongst several other contemporary introductions for extended trial and selection work.

A family of 50 plants was grown in 1926–27 from the plant selected. From this, further selections were made and families grown on in the following year (1927–28). The seed of one of these families was bulked to produce the present strain of " Delrect No. I."

The original Delta Webber cotton had been found to be very prone to lodge, with consequent loss and deterioration of cotton. The newly selected strains were specially bred for erectness, and stand up satisfactorily, though not entirely free from liability to lodge when bearing a heavy crop. The name " Delrect " has been given in allusion to this relatively erect growth habit. The strain was also specially selected for length and quality of lint, and the examination made by the Plant-Breeding Section shows the result to have been satisfactory.

In yielding power Delrect No. I has given very encouraging results, both in the Breeding plots and in the Propagation plot which was grown this year at Shendi, where a yield of 4·7 large kantars (approximately 1,500 lbs.) of seed cotton was obtained from 1 feddan, despite very thin sowing due to lack of sufficient seed.

A block of 40 feddans of this type is being grown at Mikeilab during the coming season as the first step in large-bulk propagation. Half of this area will be treated as a roguing plot.

*Delta Webber No.* 6.—This is the latest of Messrs. Cokers' own productions in this line and gave satisfactory results, but did not appear to be quite equal to Delrect No. 1 in lustre and strength. The two types will be tested out together in the coming season. It is of interest to note that one of this same firm's earlier selections from this variety (" Delta Webber No. 5 ") was this year grown at Zeidab by the Sudan Plantations Syndicate and gave a very good yield.

*Uganda American S.G.* 15 *and S.G.* 26.—These are two selected types produced at the Serere Plant Breeding Station in Uganda. Half-feddan plots of each were grown at Shambat, and Mr. March has also grown them in Nuba Mountains Province. At Shambat, S.G. 15 was unquestionably the better in yield, earliness and quality. It is a very attractive cotton and will be given extended trial in the coming season. Both gave indications, however, of possessing a low ginning out-turn.

*Wild's No.* 1 is another type produced by Coker's Pedigreed Seed Company. Only a very small plot (¼0th feddan) was grown, but the plants appeared to be so satisfactory in yield and quality and particularly in the matter of clean, healthy growth, that a further supply of seed has been obtained sufficient for a full scale series of tests in the Southern Provinces during the coming season.

*Parnell's Jassid-Resistant types.*—Here again only very small plots were grown. The chief point of interest with us in connection with these types lies in their apparent resistance to Leaf Curl disease, mentioned in a previous section, and in the possible relation between this resistance and the property of jassid resistance for which the strains were originally selected.

All four types will be carried on in the coming season, and U. 4 and A. 12 will be tried out in a preliminary variety test.

*Massey's Selected Domains Sakel.*—As in previous years, this was the type grown on the whole of the Shambat Pump Scheme (400 feddans), a special area of 20 feddans being sown with pure seed and treated as a roguing plot. It has maintained its reputation for exceptional strength and has continued to give excellent results in spinning tests. It is, however, rather dark in colour and on the coarse side and will eventually be replaced by other types.

*Sakel* 186/24 is one of several strains isolated and handed over by Mr. Massey and subsequently tested out by us both at Shambat and in the Gezira. It is believed, as the result of these tests, to be the best of these strains and to be superior to the type at present grown in the Gezira. It first attracted our attention as being less susceptible to high temperature effects (as evidenced by the production of fruiting branches lower down on the stem) than the usual run of Sakels. It has now been tested out at two stations in the Gezira for three years in succession, a representative of the ordinary main crop of the Gezira being included for comparison in each case. The results of these tests will be found in another section of this Report and in previous Reports, but may be briefly summarised as follows :—

| | |
|---|---|
| 1926–27 ... | *Wad Medani Variety Test.*<br>First in order out of six varieties.<br>(Gezira " Main Crop " was fifth in order—about 7 % less.)<br>*Barakat Variety Test.*<br>First in order out of six varieties.<br>(" Main Crop " was fifth, and about 6 % less in yield.) |
| 1927–28 ... | *Wad Medani Variety Test.*<br>First in order out of six varieties.<br>(" Main Crop " was fifth—about 5 % less.)<br>*Barakat Variety Test.*<br>Second in order out of six varieties.<br>(" Main Crop " was fourth—about 7 % less.) |
| 1928–29 ... | *Wad Medani Variety Test.*<br>Second in order out of six varieties.<br>(" Main Crop " was fifth—about 7 % less.)<br>*Barakat Variety Test.*<br>First in order out of six varieties.<br>(" Main Crop " was sixth—about 10 % less.) |

The cotton spins satisfactorily and has an attractive appearance. Steps are being taken to propagate without further delay, and it is hoped to have 15 feddans in the coming season, grown from in-bred seed and surrounded by a protective belt of 10 feddans.

*Garofallou.*—This was a type introduced from Egypt in 1925. Propagation has been confined to keeping a stock of relatively pure in-bred seed for testing purposes. In appearance the cotton is unattractive and distinctly shorter and coarser than Sakel, but it has always been found to spin remarkably well—an experience which has been confirmed by parallel tests conducted in Egypt.

In all these propagation plots, except those in which Delrect No. I and Coker's Delta Webber No. 6 were grown, both of which were in thoroughly isolated positions, flower selfing was carried out as a regular routine. About 47,000 flowers were selfed during the course of the season by the conical bag method.

The propagation plots suffered like the rest of the farm from excessively heavy boll shedding. Over 95% of the selfed flowers "set," but only about 28% finally reached maturity. The percentage of boll shedding rose as the season progressed, doubtless due to the incidence of boll worm.

The ginning out-turn has been disappointingly low from all the propagation plots at Shambat this year. This appears to have been a seasonal effect, as it held good for both Egyptian and American types and also for the American Variety Test Plots at Shendi and Moeis, situated further north.

Sakel 186/24 and S.I.A. 2.7 were the only two types which gave an out-turn of over 30%. The others mostly ranged between 28 and 29%, except for the Shambur Sakels and the Uganda American cottons which came out at 25% or less. These will all doubtless give much better results in another season.

### 3. Cotton Variety Testing.

The sites for the plots and the method of layout employed were similar to those used for the previous season's work.

The plots laid down were as follows :—

(A) Egyptian and Allied Types of Cotton.

*I. Preliminary Variety Test* (*Irrigated*).

Experimental Farm, Shambat.

*II. Standard Test Series* (*Irrigated*).

(i) Shambat Pumping Station.
(ii) Wad Medani (Gezira Research Farm).
(iii) Barakat (Sudan Plantations Syndicate Seed Farm).

} Gezira tract

(B) American Types of Cotton.

*I. Standard Test Series* (*Irrigated*).

| | |
|---|---|
| (i) Shendi (Karu soil).<br>(ii) Moeis (New river-soil). | On Gendettu Pumping Scheme. |
| (iii) Kober (Karu soil). | On estate of Mr. Aziz Kfouri, near Khartoum. |

*II. Standard Test Series* (*Rain-grown*).

| | |
|---|---|
| (i) Talodi.<br>(ii) Kadugli. | Nuba Mountains district. |
| (iii) Sabonabi-es-Sherig.<br>(iv) Ghati. | Fung Province. |

A general description of the districts concerned was given in last year's Report and need not be repeated here. The plots were situated on land closely adjacent to the plots of last year.

We wish to express our indebtedness to Mr. Aziz Kfouri and the Sudan Plantations Syndicate as well as to the Chief Inspector, Gezira Research Farm and to those Inspectors of Agriculture without whose help the tests could not have been carried out.

All plots gave satisfactory results except those at Shambat (Pump Scheme) and Kober, at both of which places the yield was extremely low, and at Sabonabi, where, owing to deficient rainfall, no cotton at all was picked.

The data obtained from the variety test plots have been worked up in a rather similar manner to that employed last year, and the same method of obtaining "probable corrections" has been used. (This method is explained in a paper entitled "Cotton Variety Testing in the Sudan," which will shortly be published by the Sudan Government.)

The method previously employed of comparing the yields of varieties on the basis of the "standard error of mean difference" has been discarded and Fisher's "Analysis of Variance" method has been employed in its stead. I am indebted to Dr. F. G. Gregory for much assistance and guidance in the use of this method.

The stages employed in the analysis in the case of these plots are:—

(i) Calculation of total variance.

(ii) Estimation of residual variance, after eliminating variance due to known causes such as varietal differences, differences due to soil heterogeneity between blocks, and differences due to soil fertility gradient within blocks.

(iii) Estimation of the significance of the variance due to varietal differences by comparison with residual variance by means of the "Z test."

(iv) Comparison of the variance due to difference in yielding power of all pairs of varieties with the residual variance (as calculated above), and estimation of the significance of these varietal differences by means of the "Z test."

In presenting the results in this Report the actual yields are first given and comparisons made on the basis of Fisher's method, using a probability of P = ·05 (20 to 1) as the lowest limit of significance.

It will be found that in most cases this method enables certain varieties to be separated at once as showing significant differences in yield. The "probable corrections," based on the deviations of the average yield values of adjacent beds, taken in groups of three, from the mean values for the three varieties concerned, are also given; these may be expected to place the varieties more nearly in the true order of merit which they should occupy, apart from purely accidental circumstances.

### A. (*I.*) Preliminary Variety Test (Irrigated).

All the types grown in this plot still exist only in very small quantity, except the variety known as "Massey's Selected Domains," with which the Shambat Pump Scheme as a whole is sown.

Garofallou is a type introduced from Egypt some years back, which appears to yield well and to give lint which spins into very strong yarn. For these reasons it has been retained in the Preliminary Variety Test though its relatively coarse and unattractive appearance has caused it to receive unfavourable valuations from the Graders.

All seven varieties were included in the previous year's test, except Shambur Sakel I, which has taken the place of NT 25/24.

The field had received a dressing of dung (5 tons per feddan) during the previous winter, which doubtless accounted for the yield obtained, viz., 2·6 large kantars per feddan (nett area). This yield, though not high, is satisfactory and decidedly better than the average for the farm for this season. Sowing was done on August 17th, after a heavy preliminary watering on the 13th. Sulphate of Ammonia was applied (2 cwt. per feddan) about two months after sowing.

Germination and stand were both excellent and growth satisfactory and even in the early stages, but bottom shedding was very heavy, as elsewhere on the farm, with consequent delay in flower production.

Blackarm was negligible in amount, and Stem-borer caused no trouble this season. Thrips was rather prevalent right at the start but the plants quickly grew out of it. The crop as a whole was thrown late by the shedding already mentioned, and heavy losses from boll worms occurred in March and April.

Leaf Curl appeared late in the season. It spread quickly and was severe in places. The varieties appeared to show definite differences in their power of resistance, Shambur Sakel I and S.I.D. 3.2, being the worst attacked and Garofallou and Massey's Domains the least.

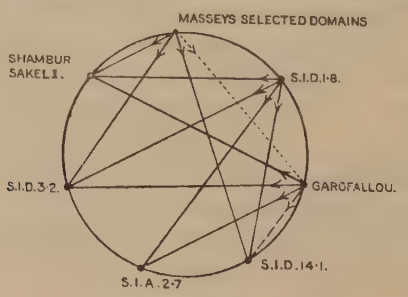
An attempt was made to correlate the degree of severity of attack in individual beds with the yield from the late pickings, but gave no clear result.

The final yield results are summarised in the following table, the varieties being arranged in descending order :—

| *Varieties.* | *Mean Bed Yield in Rottles.* | *Mean Bed Yields Corrected on Basis of Yields of Adjacent Beds.* | *Order of Merit (after Corrections).* |
|---|---|---|---|
| Massey's Selected Domains ... | 146·2 | 141·8 | Unaltered |
| S.I.D. 1.8 ... ... ... | 137·5 | 137·1 | ,, |
| Garofallou ... ... ... | 133·0 | 136·9 | ,, |
| S.I.D. 14.1 ... ... ... | 117·0 | 114·6 | ,, |
| S.I.A. 2.7 ... ... ... | 112·4 | 112·9 | ,, |
| S.I.D. 3.2 ... ... ... | 109·6 | 111·6 | ,, |
| Shambur Sakel I ... ... | 106·7 | 106·0 | ,, |

The method of analysis of variance (see general note on this method at the head of this section) showed that varietal differences had had a very significant effect in determining the yields and that soil heterogeneity, as measured by the variance between successive blocks of varieties, had been of very slight account.

The application of the " Z test " to differences in (" uncorrected ") yields between pairs of varieties shows certain of these differences to be statistically significant. (Taking P = ·05 as the basis of significance).



The " Z test " has been applied to all pairs of differences in this case, and the results are shown diagrammatically below. When the difference is highly significant, the varieties are joined by a solid line in the diagram ; when it is only just significant they are joined by a broken line, and when nearly but not quite significant by a dotted line. The arrow in each case leads from the variety with the higher observed yield to that with the lower. Varieties which are not significantly different in yield are left unjoined.

Reference to the list of " corrected " yields given above increases the probability of the observed difference between Garofallou and S.I.D. 14.1 being a real one, but throws increased doubt on the validity of the observed difference between Massey's Selected Domains and Garofallou.

Flower counts were carried out on this plot at six different times during the season, the counts themselves being the average of three successive days in each case. These flower counts give us direct information as to the earliness or lateness of flowering, and, by comparison with the appropriate picking curves, give indirect evidence as to the extent of boll shedding in each variety.

The information obtained may be summarised as follows :—

*Massey's Selected Domains.*—Medium late in starting to flower, and took nearly a month to pull ahead of the others in flower production rate, but never equalled Garofallou in this respect, until nearly at the end of the first burst of flowering. In the early stages it showed less boll shedding than the others, except Garofallou, and was never particularly bad.

*S.I.D.* 1.8.—One of the earliest to flower ; presumably connected with observed ability to form fruiting branches lower down than the others. This variety gave a consistently high rate of flower production, and would have come out top in yield if it had not been about the worst for boll shedding at practically all stages.

*Garofallou.*—Decidedly the latest in starting to flower. (This variety showed a marked delay in the production of fruiting branches.) One month later, however, it flowered more freely than any of the others, but soon dropped to a low level again. It owes its relatively high position in order of yield to comparatively slight shedding, except for one bad period of limited duration in mid-season.

*S.I.D.* 14.1.—This was the next earliest to S.I.D. 18, and was fairly consistent throughout in the matter of flower production. Boll shedding was rather bad on the whole.

*S.I.A.* 2.7.—Rather late in starting to flower and always about the lowest in flower production, but better than D. 14·1 and the two which follow as regards boll shedding.

*S.I.D.* 3.2.—Rather a late starter and never more than a medium heavy flowerer. Boll shedding bad.

*Shambur Sakel I.*—Late starter and never strong in flower production, but carried on at a moderate rate for a longer time than most. The individual picking curves are disappointingly low, compared with the flowering curves, but the lack of fit between the two sets of curves suggest that some factor, other than, or in addition to, boll shedding must have been responsible for the loss of potential crop.

This last variety was rather particularly affected by " bad boll-opening," and in order to get some idea as to how far this was influenced by droughty conditions, one of the " Belt " beds of this plot was sown with this variety and extra waterings given after the first week in December. This bed gave a very much better yield than other beds of the same variety and appeared to open rather better, but this must be regarded as an indication only, as the treatment was not " replicated."

The ginning out-turn was obtained for each picking of each variety and showed the usual tendency to rise throughout the season, except in the case of Shambur Sakel I and Garofallou, where it fell noticeably in the last pickings. The average values (for all pickings) came out as follows :—

| | *Per Cent.* | *Order of Merit.* |
|---|---|---|
| Massey's Selected Domains ... ... | 30·6 | 1 |
| S.I.D. 1.8 ... ... ... ... ... | 27·6 | 6 |
| Garofallou ... ... ... ... ... | 28·5 | 4 |
| S.I.D. 14.1 ... ... ... ... ... | 29·0 | 3 |
| S.I.A. 2.7 ... ... ... ... ... | 29·5 | 2 |
| S.I.D. 3.2 ... ... ... ... ... | 28·5 | 4 |
| Shambur Sakel I ... ... ... ... | 26·7 | 7 |

All the varieties were included in a similar test in the previous two seasons, except Shambur Sakel I. The figures for ginning out-turn given above show a rough similarity to those of the previous year, but the same cannot be said of the yield figures, which bear rather more resemblance to those of 1926–27.

Taking the three years together it would seem that the best yielding varieties are Garofallou, S.I.D. 1.8 and Massey's Selected Domains; of the remainder S.I.D. 3.2 is probably the best in yield though the higher ginning out-turn of S.I.D. 14.1 should put it about level.

This season's detailed observations agree with those of previous years as regards the late starting and comparatively slight shedding of Massey's Domains, Garofallou and S.I.A. 2.7, and the earliness and low-borne sympodia of S.I.D. 1.8.

Notes on the behaviour of these and other varieties in spinning and grading tests will be found in a later section.

A. (*II.*) Egyptian, etc., Varieties (Standard Series) (Irrigated).

(i) Shambat Pumping Scheme.
(ii) Wad Medani.
(iii) Barakat.

The layout was on the standard strip system with six varieties repeated five times, the replicates being grouped into five blocks. The two end strips were protected by belt strips in each case. The total area of each plot was 5 feddans.

The varieties tested were as follows :—

Bolland Sakel 8.
Massey's Selected Domains Sakel.
Main Crop (Gezira).
Sakel B/24.
Sakel 186.
Nahdah.

All these varieties had previously appeared in variety tests for two years in succession.

All the plots were pre-watered before sowing, the tilth was satisfactory and germination good. The resulting stand of plants was excellent as regards regularity at Shambat and Wad Medani and very fair at Barakat. In no case were the irregularities in stand sufficiently great to be reflected in even the earliest pickings.

The plots at Wad Medani and Barakat gave satisfactory yields, but the Shambat plot, despite a dressing of Sulphate of Ammonia, gave a very subnormal yield, due partly to the season and partly to the plot having been sited on a relatively poor piece of land.

The following details are given for individual plots :—

*Shambat.*—Sown, August 19th. Re-sown, September 5th. Thinned and spaced, October 4th and 21st. Final spacing, 90 cms. × 45 cms. Practically no rain fell after sowing. Three after-cultivations were given. Waterings were given at intervals of about 15 days. Sulphate of Ammonia (2 cwts. per feddan) was applied on October 19th. The soil varied very widely in character, from sandy silt to heavy silty loam, but the irregularities in general affected a number of beds together.

Growth was poor and stunted throughout, especially on the lighter patches of soil. Early shedding was very bad and practically all the crop came from flowers produced in December and January.

No Blackarm was recorded, and other diseases, including Leaf Curl were never troublesome ; Bollworm, however, destroyed the latter end of the crop.

*Wad Medani.*—Sown, August 21st. No re-sowing needed. Singled and spaced on September 21st. Final spacing, 80 cms. × 50 cms., but irregular. Two after-cultivations given. A fair amount of rain fell after sowing. Waterings were given at intervals of about 15 days, except during the first 50 days, when rain made it unnecessary to give more than two irrigations. The soil was of normal Gezira type, but varied very considerably in cropping power as evidenced by the very high figure obtained for variance between the yields of blocks.

Growth was strong and vigorous and the plants were flowering heavily when seen in mid-November.

Blackarm was quite bad in the early stages but was not of much importance after early November. Leaf Curl was general by the end of the season.

*Barakat.*—Sown between August 21st and 24th, the delay being due to a fall of half-an-inch of rain on August 22nd. Resown, September 9th. Thinned and spaced on September 24th and October 8th. Final spacing, 80 cms. × 45 cms. Frequent cultivations given. Waterings at intervals of about 15 days.

Growth was fairly vigorous at the start, but the plants looked yellow and spindly in early October recovering later in November.

Blackarm was slight during September but rather bad during the last two weeks of October, and still fairly active in early November. The soil was similar to that at Wad Medani with an only slightly less-marked range in fertility.

The method of analysis of variance when applied to the above plots this year gave disappointing results; the range of difference between the yields of varieties was relatively small, and even after eliminating the very considerable variance due to difference in block yields, it was found that the variance due to varietal differences did not reach a significant level, though this was approached in the case of the Shambat plot.

On the other hand, if the varieties are compared in pairs on the basis of the "residual variance," it is found that, in the Shambat plot, Nahdah appeared to be significantly better in yield than the three next varieties in order (see yield table below), and almost but not quite significantly better than all other varieties tried at that place.

The actual yields and probable corrections are shown in the following table :—

| Varieties. | Shambat. Average Net Yield per feddan = 1·4 Large Kantars. | | | Wad Medani. Average Net Yield per feddan = 4·01 Large Kantars. | | | Barakat. Average Net Yield per feddan = 3·5 Large Kantars. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Uncorrected Yields. | | Probable Corrections. | Uncorrected Yields. | | Probable Corrections. | Uncorrected Yields. | | Probable Corrections. |
| | Rottles per Bed. | Order of Yield. | | Rottles per Bed. | Order of Yield. | | Rottles per Bed. | Order of Yield. | |
| Bolland Sakel 8 ... | 49·2 | 4 | +0·3 | 151·9 | 6 | +5·7 | 137·6 | 4 | +5·2 |
| Massey's Selected Domains... ... | 48·5 | 5 | +2·8 | 156·5 | 4 | +1·3 | 137·8 | 4 | — |
| Main Crop Gezira ... | 48·5 | 5 | +1·7 | 153·8 | 5 | +3·9 | 132·4 | 6 | +3·6 |
| Sakel B/24 ... ... | 54·1 | 3 | −2·2 | 165·8 | 1 | −2·0 | 145·0 | 2 | −3·4 |
| Sakel 186 ... ... | 54·5 | 2 | −1·2 | 164·7 | 2 | −4·5 | 148·4 | 1 | −7·7 |
| Nahdah ... ... | 68·6 | 1 | −2·4 | 157·4 | 3 | −5·5 | 139·2 | 3 | +1·9 |

If the figures for the two nearly adjacent plots at Wad Medani and Barakat are averaged together, the following results are obtained :—

| Varieties. | Average of Wad Medani and Barakat Plots. | | |
|---|---|---|---|
| | Uncorrected Yields. | | Probable Corrected Yields in Rottles. per Bed. |
| | Rottles per Bed. | Order of Yield. | |
| Bolland Sakel 8 ... ... ... ... ... | 144·7 | 5 | 150·1 |
| Massey's Selected Domains... ... ... ... | 147·1 | 4 | 147·7 |
| Main Crop Gezira ... ... ... ... ... | 143·1 | 6 | 146·8 |
| Sakel B/24 ... ... ... ... ... ... | 155·4 | 2 | 152·7 |
| Sakel 186 ... ... ... ... ... ... | 156·5 | 1 | 150·4 |
| Nahdah ... ... ... ... ... ... | 148·3 | 3 | 146·5 |

The results of this season may now be compared with those of the previous two seasons. This is done below, making use of the " corrected " yields in the case of the last two seasons. Only the order of yields is shown and it must be remembered that the differences between individual varieties are often very slight.

SUMMARY OF RESULTS OF LAST THREE SEASONS' TESTS.
(Varieties arranged in order of yield.)

| | 1926–27. | 1927–28. | 1928–29. |
|---|---|---|---|
| SHAMBAT PLOT ... | Nahdah<br>Bolland 8<br>Selected Domains<br>Main Crop<br>Sakel B/24<br>Sakel 186 | Nahdah<br>Bolland 8<br>Sakel B/24<br>Sakel 186<br>Selected Domains<br>Main Crop | Nahdah<br>Sakel 186<br>Sakel B/24<br>Selected Domains<br>Main Crop<br>Bolland 8 |
| AVERAGE OF WAD MEDANI AND BARAKAT PLOTS ... | Sakel 186<br>Selected Domains<br>Sakel B/24<br>Main Crop<br>Bolland 8<br>Nahdah | Selected Domains<br>Sakel 186<br>Sakel B/24<br>Main Crop<br>Bolland 8<br>Nahdah | Sakel B/24<br>Sakel 186<br>Bolland 8<br>Selected Domains<br>Main Crop<br>Nahdah |

Taking the three years together, it is clear that the variety which has been most successful in yielding power in the Gezira tract is Sakel 186, followed closely by Sakel B/24 and Massey's Selected Domains. As explained in the section of this Report which is devoted to "propagation," arrangements are being made to multiply up a relatively pure strain of Sakel 186 as rapidly as possible with a view to its introduction into this area.

It will be seen that the sample of "Main Crop" grown in these trials gave relatively poor results compared with the new types in all three years. In the first year the "Main Crop" seed was obtained from Wad Sulfab in the Gezira and in the other two years from Tokar.

Nahdah always occupies the lowest position in the Gezira tests both in yield and price, and will be dropped from these trials.

The deductions to be made from the results of the three years' trials at Shambat are not so clear, as the order tends to vary more than in the other plots, but it is evident that Nahdah is the most successful yielder in this district, and that "Main Crop" seed (as used in the Gezira) again gives uniformly poor results compared with the other varieties tried. In the season just past Sakel 186 has given really good results at Shambat as well as in the Gezira, thus emphasising the utility of this variety.

Figures for ginning out-turn are available this year only for Shambat (average of all pickings) and for Wad Medani (samples from third picking only).

The results were as follows :—

| *Shambat.* | | *Wad Medani.* | |
|---|---|---|---|
| Nahdah ... ... ... | 32·2 *per cent.* | Nahdah ... ... ... | 33·7 *per cent.* |
| Sakel 186 ... ... ... | 32·1 „ | Bolland Sakel 8 ... ... | 33·7 „ |
| Main Crop Gezira ... ... | 31·9 „ | Main Crop ... ... ... | 33·3 „ |
| Massey's Selected Domains | 31·5 „ | Sakel 186 ... ... ... | 32·1 „ |
| Bolland Sakel 8 ... ... | 30·6 „ | Massey's Selected Domains | 31·7 „ |
| Sakel B/24 ... ... ... | 30·7 „ | Sakel B/24 ... ... ... | 31·7 „ |

The respective positions of Nahdah and Sakel B/24 at the top and the bottom of the list in both places confirm the results obtained last year at Shambat, and the tendency for Sakel 186 and Main Crop to occupy the next highest positions to Nahdah is also borne out by reference to the previous year's results.

At Shambat and Wad Medani the protective belt strips were sown up with new types of cotton for the purpose of obtaining preliminary indications as regards yielding power and general behaviour. At Shambat, seed of a selected strain known as "Assili A. 143. 7.9," received from Mr. Massey, was tried in both belt beds. This type did decidedly better than the others in the plot in the earlier pickings, but fell away at the end. It was probably not equal to Nahdah either in yield or quality, though very likely superior to the Sakel types tried in the matter of yield alone. Lack of adequate replications makes it impossible to attempt closer comparison.

At Wad Medani, one belt was sown with "Shambur Sakel I," and the other with a type "S.I.D. 3.2," which had previously been tried only in the Preliminary Variety Test. Both gave yield results inferior to the other varieties tried. The former, however, suffered from irregularities in watering and would probably have done better had it not been for this. It produced its fruiting branches low down and flowered freely.

Developmental observations made on these three test plots show that early node production rate was a factor of major importance in early yield at Shambat, but not at the other plots. This is probably due to the fact that shedding was extremely severe at Shambat, whole sympodia or large portions of them being lost frequently. Under such conditions each additional stem node formed would give an extra chance. The order obtained for rapidity of node production was the same at Wad Medani and Shambat and agrees almost exactly with that noted last year :—

1. Sakel B/24 } quickest.
2. Main Crop }
3. Bolland Sakel 8.
4. Sakel 186.
5. Massey's Selected Domains.
6. Nahdah—slowest.

Detailed determinations of the position of the lowest effective sympodium are available for Wad Medani only, but appear to be confirmed by some scanty observations at Barakat. The order at Wad Medani was as follows, the varieties which produced sympodia lowest down being placed at the head of the list :—

1. Nahdah.
2. Bolland Sakel 8.
3. Sakel 186.
4. Main Crop.
5. Massey's Selected Domains.
6. Sakel B/24.

This order is the same as that obtained last year, except that Bolland Sakel 8 and Sakel 186 have changed places and Sakel B/24 has dropped two places.

Observations made on the degree of Blackarm infestation did not appear to show a direct relation between this and subsequent yield, as had been noted in certain plots in the previous season.

Three-day flower counts made at Shambat and Wad Medani when compared with picking curves suggest that Nahdah is more inclined than the other varieties to shed in the early stages of boll production. Bolland Sakel 8 and Sakel B/24 were probably the next most liable to boll shedding, except for Massey's Selected Domains, in the case of the first picking bolls only.

In actual earliness of crop arrival, Gezira Main Crop and Sakel B/24 appeared to show a slight advantage, but the former tailed off in mid-season and later pickings. Nahdah and Massey's Selected Domains both tend to lateness in starting, but both " finish " well.

B. (*I.*) American Varieties (Standard Series) Irrigated Plots.

(i) Shendi.
(ii) Moeis.
(iii) Kober.

The varieties tested were :—

Delta Webber.
Webber No. 10.
Pedigree Dixie.
Pump Scheme Strain.
Webber 38.

The layout employed was our standard strip-test system : Total area 5 feddans, divided into 27 equal strips of which the two end strips were " belt " strips and the remaining 25 were distributed amongst the varieties, giving five replications of each. The varieties were grouped in blocks and " balanced " within the blocks.

Webber 10 appears in this series for the first time. The remainder were all on test for the third year in succession.

In all three plots the tilth was good at the time of sowing and a very satisfactory stand of plants was obtained, though at Shendi the plants came up in two flushes separated by 7–10 days, owing to the soil not being quite sufficiently wetted in the first instance.

Weeds were never really troublesome. They were worst on the Shendi plot, but do not appear to have had any differential effect on yields. Insect pests were unimportant and Blackarm absent or nearly so.

The following details refer to individual plots :—

*Shendi.*—Sown, July 7th. Resown, July 21st. Thinned and spaced, August 15th. Final spacing, 90 × 45 cms., except in the case of the belt beds which were left at the closer spacing of 90 × 22½ cms. Cultivated four times. Soil decidedly light in type for Karu. Waterings were given rather irregularly, but growth was satisfactory and rather inclined to be rank.

The irregular germination was reflected very clearly in the yields obtained in the first picking, but as this effect was almost completely neutralised in the second and third pickings, its effect on final yield was probably not important.

The close-grown belt beds which were sown with Pump Scheme Strain yielded better at all stages than the most nearly adjacent beds of the same variety, but this result must be accepted with caution in view of the lack of replications and the fact that the result is contrary to that obtained last year.

*Moeis.*—Sown, July 7th. Re-sown, July 19th. Thinned and spaced on August 16th. Final spacing, 90 × 90 cms., except belt beds which were left at 90 × 45 cms. Cultivated four times. Watered at intervals of about 13–15 days. The soil was very even throughout—a fine friable light-coloured silt y soil, giving an excellent seed bed.

Growth was vigorous, and the plants, especially those in the closer-sown belt beds, grew very thick and tall. The effect of the closer spacing in this case appeared to be in the direction of lighter pickings, especially in the early stages of crop production.

Records taken of delayed germination, irregularities in stand and degree of weediness of the beds showed that none of these factors had any appreciable effect on the yield, and the results may be taken as quite reliable for the particular situation.

*Kober.*—Sown, July 26th. Re-sown, August 8th. Thinned and spaced, September 9th and October 6th. Final spacing, 90 × 45 cms. for all beds. Difficulty was experienced in obtaining a regular supply of water for the plots, the intervals between waterings being approximately 2 weeks up to early November and 3 weeks after that time. The surface soil was fairly light and germination was satisfactory. Atabout 9 inches down, however, the soil became dark-coloured with a lot of whitish flecks. In the third foot itbecame lighter in colour again, and extremely hard with a network of white concretions.

Growth was extremely poor from the start and the roots never penetrated much below the 9 inch level. Practically no second growth

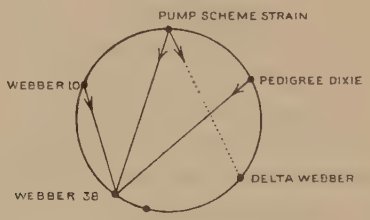
was made, and at the end of the season the plants over large areas did not exceed a foot in height. The conditions here were clearly unsuitable to the growth of American cotton, though fair crops of the stronger-rooting Sakel can be obtained. A dressing of Sulphate of Ammonia was applied (2 cwts. per feddan) on October 15th, but produced very little improvement.

The results from these three plots were treated statistically in the same manner as was employed for the Preliminary Variety Test and Egyptian Variety Tests. (See above.)

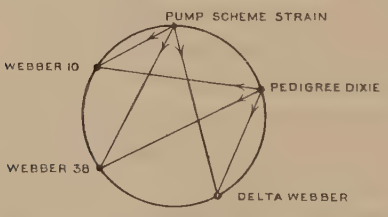
Variance due to varietal differences was found to be significantly high in all three cases. At Shendi and Moeis soil irregularity, as measured by the variance between blocks, was considerable and produced variances of the same order of significance as that caused by the differences between varieties. At Kober, the variance due to soil differences was not important.

Comparing the varieties in pairs by means of the "Z test," we find that significant differences occurred in some cases. The results are shown diagrammatically below, using the same system as that employed in the case of the Preliminary Variety Test.

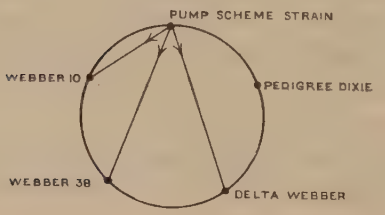
*Shendi.*




*Moeis.*




*Kober.*



The following table gives the actual yields obtained, together with the probable corrections as indicated by the yields of adjacent beds :—

| Varieties. | Shendi. Average Net Yield per feddan = 6·8 Large Kantars. | | | Moeis. Average Net Yield per feddan = 7·5 Large Kantars. | | | Kober. Average Net Yield per feddan = 1·3 Large Kantars. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Uncorrected Yields. | | Probable Corrections. | Uncorrected Yields. | | Probable Corrections. | Uncorrected Yields. | | Probable Corrections. |
| | Rottles per Bed. | Order of Yield. | | Rottles per Bed. | Order of Yield. | | Rottles per Bed. | Order of Yield. | |
| Delta Webber ... | 264·4 | 4 | −3·5 | 268·1 | 5 | −4·7 | 47·1 | 4 | +1·6 |
| Webber 10 ... ... | 277·4 | 3 | +6·6 | 294·0 | 3 | +4·7 | 45·2 | 5 | −0·2 |
| Pedigree Dixie ... | 281·7 | 2 | +2·0 | 336·1 | 2 | +6·2 | 53·3 | 2 | −0·4 |
| Pump Scheme Strain | 288·1 | 1 | −2·0 | 340·6 | 1 | −3·1 | 60·9 | 1 | −0·4 |
| Webber 38 ... ... | 246·7 | 5 | −3·7 | 269·0 | 4 | −1·2 | 51·0 | 3 | −1·3 |

The effect of applying the probable corrections would cause Webber 10 and Pedigree Dixie to change places at Shendi, and Pedigree Dixie and Pump Scheme to change places at Moeis. Otherwise the order of merit is unaltered.

The general result is to place Pump Scheme Strain and Pedigree Dixie at the top of the list for Pump Scheme cultivation, the other three types being some way behind with very little difference between them.

Taking the three stations together, we get mean values as follows :—

| | Uncorrected. | Corrected. |
|---|---|---|
| Pump Scheme ... ... ... ... | 229·9 | 228·1 |
| Pedigree Dixie ... ... ... ... | 223·7 | 226·3 |
| Webber 10 ... ... ... ... | 205·5 | 209·2 |
| Delta Webber ... ... ... ... | 193·2 | 191·0 |
| Webber 38 ... ... ... ... | 188·9 | 186·8 |

This order agrees well with that of previous years, except that Webber 38 is now below Delta Webber. Webber 10 seems to be definitely superior to the latter in yield.

It is necessary to emphasise that the lower price likely to be realised on the sale of the lint of the two varieties at the top of the list would do much to neutralise the advantage gained on yield alone. This question will be dealt with at a later stage.

The average values obtained for ginning out-turn were as follows : –

Average for all Pickings of all Three Irrigated Plots.

| | |
|---|---|
| Delta Webber ... ... ... ... ... ... | 26·4% |
| Webber 10 ... ... ... ... ... ... | 26.5% |
| Pedigree Dixie ... ... ... ... ... | 29·0% |
| Pump Scheme Strain ... ... ... ... | 26·4% |
| Webber 38 ... ... ... ... ... ... | 25·3% |

It will be noted that all these values are extremely low—this appears to have been a characteristic of the season in the northern part of the Sudan, and has already been remarked on in the case of the Shambat crops.

Field observations made during the growth of the crops gave the following additional information for Shendi and Moeis :—

*Delta Webber.*—Earlier cropper than all except Webber 10, and maintained its lead in yield for the first three pickings, after which it tended to drop behind considerably, owing to earlier ripening-off. This earliness was connected with production of fruiting branches low down on the stem and ability to hold early bolls. Early node-production rate is rather slow. Relatively slightly attacked by flea-beetle.

*Webber* 10.—Earliest of all and gave heaviest yields in first three pickings after which yields fell away rapidly. As in Delta Webber, which this variety resembled in many respects, the lowest fruiting branches were produced very well down, but early setting of bolls was not so dependable. Node-production rate was slow throughout, and the plants remained short and more or less upright with stout short sympodia. Second growth was slight. It appeared to be only moderately susceptible to flea-beetle.

*Pedigree Dixie.*—Late starter, but did very well in the mid-season pickings and quite well in later pickings. Node-production rather rapid to rapid throughout. Lowest sympodium rather late in appearing, but usually effective. It produced a lot of late monopodia and was more or less badly lodged. Susceptibility to flea-beetle appeared to be very variable.

*Pump Scheme Strain.*—Late starter, and was behind all the others for the first three pickings, after which it commenced to yield heavily and continued the best in this respect to the end. It was the tallest-growing variety and one of the quickest in node-production rate. Lateness is probably due partly to the high position of the lowest sympodium. Towards the end of the season it lodged badly, and this, combined with the strong growth of late monopodia, caused the plots to become very tangled and difficult to pick. It was one of the most liable to flea-beetle attack.

*Webber* 38.—As late as Pump Scheme Strain in starting, and showed even greater delay in production of fruiting branches, a failing which was not compensated for by a rather quick node-production rate. It was a rather tall-growing type, with a distinctive spire habit and not very prone to lodge. Flea-beetle attack was medium only.

In general, the above observations agree very closely with those made last year, the degree of susceptibility to flea-beetle alone showing important differences. The flower counts made this year were not sufficiently detailed to give reliable information on the question of boll shedding.

### B. (*II.*) American Varieties (Standard Series) Rain Grown Plots.

(i) Talodi.
(ii) Kadugli.
(iii) Sabonabi.
(iv) Ghati.

The system of layout and the varieties tested were the same as in the " Irrigated " test, the only difference being in the size of the plots which in this series was 3 feddans instead of 5.

The seed was sown on the flat in lines, at a time when sufficient rainfall had already fallen to provide a certain reserve of moisture in the soil, and to fill the cracks and break up the hard-baked surface into a fine tilth.

The following details relate to individual plots :—

*Talodi.*—Sown, June 3rd. Re-sown, June 17th. Thinned and spaced on June 18th and 26th. Final spacing, 99 × 66 cms. Rainfall during the three weeks preceding sowing, 39·2 mm. ; after sowing, 722·3 mm. ; total for season, 761½ mm. Soil a lightish loamy clay soil, passing into a sandy loam further down. Six surface cultivations given, with resulting freedom from weeds.

Germination was satisfactory except in three beds at one end of the plot, and the final stand was satisfactory all through. The beds in which germination was poor showed up to the end of the season on account of their lack of vigour. These three beds were on land which had not previously been cultivated, the other part of the plot having previously borne native crops of dura. The cotton did well throughout and was still vigorous in appearance at the end of December.

*Kadugli.*—Sown, June 26th. (Dates of re-sowing, thinning, spacing and weeding not supplied.) Final spacing, 99 × 66 cms. Rainfall during three weeks preceding sowing, 83 mm. ; after sowing, 641·5 mm.; total for season, 900·6 mm. Soil intermediate in character between cotton soil and a lighter coloured silty loam, becoming a sandy loam further down.

Germination was only fairly satisfactory and considerable re-sowing was carried out. The irregularities produced were not sufficient to

have any clearly marked differential effect on the subsequent yields of individual beds, but are probably largely responsible for the low degree of significance of variance due to varietal difference noted later on.

The earliest pickings were particularly heavy at Kadugli, and the weights picked tailed off very rapidly after early January, about a month sooner than at Talodi, where the growth altogether was more vigorous and prolonged.

*Sabonabi.*—Sown, August 3rd. Re-sown, August 15th. Thinning and spacing, September 12th and 25th. Final spacing, 99 × 66 cms. Rainfall during three weeks preceding sowing, 89·5 mm. ; after sowing, 196·5 mm. ; total for season, 394 mm. The soil was a very heavy black cotton soil for about 1 metre depth, overlying a sandy subsoil.

Germination was satisfactory, but the crop suffered from drought from the earliest stages and hardly grew at all. By mid-October the plants were thin, wiry and almost leafless, not more than 30 cms. high and practically completely barren.

*Ghati.*—Sown, August 2nd. Re-sown, August 14th. Thinning and spacing to 99 × 66 cms. on September 5th and 18th. Rainfall during three weeks prior to sowing, 57 mm. ; after sowing, 279 mm. ; total for season, 446·5 mm. The surface soil was a rather light-coloured cotton soil of heavyish texture. The subsoil was for the most part heavy clay down to a considerable depth, but at the extreme end of the plot light sand came within 120 cms. of the surface. At this end the plants had gone so droughty that the crop was neglible in most of the beds of the final block. This end of the plot was therefore cut out, leaving only four blocks of strips instead of five.

Germination was only moderately regular, but after re-sowing the final stand was quite satisfactory. Except at the dry end of the plot, growth was quite vigorous up to a point, and the plants were still green and fresh looking at the end of October. Shortly after this, however, the moisture in the soil became really deficient and the plants dried off rapidly, giving two small pickings only. Bollworm did rather much damage, and, at the ends of the beds grasshoppers stripped the plants of leaves, but this damage was more or less evenly distributed between the varieties.

Statistical treatment of the data from the above plots gave the following results :—

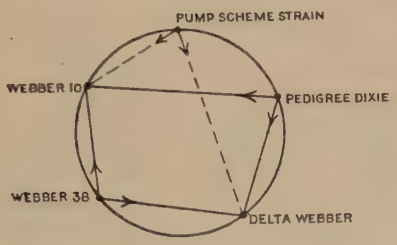
Variance due to varietal differences was fully significant at Talodi, not quite significant at Kadugli, and not significant at Ghati.

Variance due to soil differences between blocks was significant at Kadugli and highly so at Talodi, but not so for the four blocks at Ghati. Comparison of the varieties in pairs indicates certain significant

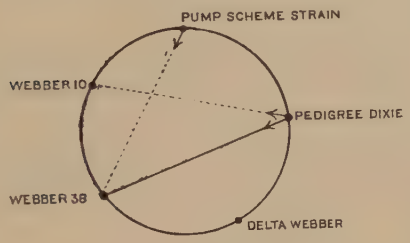
differences in mean yields, as indicated below, but these results must be accepted with added caution at Kadugli and Ghati.

The results are shown below using the same diagrammatic method as that employed in the case of the Irrigated Test Plots :—

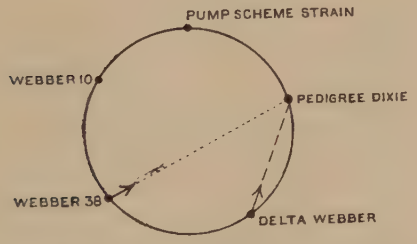
*Talodi.*




*Kadugli.*




*Ghati.*




The actual yields for these plots and probable corrections to be applied are given in the following table :—

| *Varieties.* | Talodi. *Average Net Yield per feddan = 2·9 Large Kantars.* | | | Kadugli. *Average Net Yield per feddan = 2·3 Large Kantars.* | | | Ghati. *Average Net Yield per feddan = 0·3 Large Kantars.* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Uncorrected Yields.* | | *Probable Corrections.* | *Uncorrected Yields.* | | *Probable Corrections.* | *Uncorrected Yields.* | | *Probable Corrections.* |
| | *Rottles per Bed.* | *Order of Yield.* | | *Rottles per Bed.* | *Order of Yield.* | | *Rottles per Bed.* | *Order of Yield.* | |
| Delta Webber ... | 82·5 | 4 | −0·6 | 71·7 | 3 | +0·3 | 10·5 | 1 | — |
| Webber 10 ... ... | 82·6 | | +1·0 | 70·5 | 4 | −2·4 | 8·8 | 4 | — |
| Pedigree Dixie ... | 99·7 | 1 | −1·4 | 81·4 | 1 | −3·0 | 7·3 | 5 | — |
| Pump Scheme Strain | 93·3 | 3 | +1·1 | 75·2 | 2 | +2·2 | 9·8 | 2 | 0·1 |
| Webber 38 ... ... | 96·9 | 2 | −2·2 | 63·8 | 5 | −0·3 | 9·9 | | 0·4 |

Taking the three localities together we get the following mean values :—

| | *Uncorrected.* | *Corrected.* |
|---|---|---|
| Pedigree Dixie ... ... ... ... | 62·8 | 61·3 |
| Pump Scheme ... ... ... ... | 59·5 | 60·5 |
| Webber 38 ... ... ... ... | 56·8 | 55·8 |
| Delta Webber ... ... ... ... | 54·9 | 54·8 |
| Webber 10 ... ... ... ... | 53·9 | 53·4 |

The final order of the varieties at Ghati is the same as that obtained in the previous season's test, but the results from the other two plots do not agree either with each other or with previous results from the Talodi district. Further, the order of yield obtained by averaging the three plots does not agree with the order obtained by a similar process of averaging last year's resutls.

Webber 38 is bottom of the list this year at Kadugli, but second at Talodi. It might be suggested that the conditions which produced a high average yield at Talodi this year were specially favourable to this variety, but reference to the previous season's results at Talodi, when an even higher average yield was obtained, shows that Webber 38 was then bottom.

Delta Webber this year was third in order of yield at Kadugli and lowest yielder at Talodi. Previously this variety has always occupied either first or second place in trials in the zone of medium or light rainfall, and had come to be regarded as the most consistently good performer of the varieties tried. Only at Ghati has this variety managed to retain its " correct " position. No satisfactory explanation can be put forward at the present time of this reversal of form.

The figures obtained for ginning out-turn (percentage) are of considerable interest. The values obtained at Talodi and Kadugli are both of about the same order, and average considerably higher than those obtained for the irrigated plots in the northern Sudan. The values given by the water-starved Ghati plot are all extremely low.

In the following table the values for Talodi and Kadugli are taken together and averaged and the figures for the irrigated plots, already shown elsewhere, are repeated here for comparison :—

| | Ginning Out-turn Percentages. (*Averages for all Pickings.*) | | (*For comparison.*) *Values for Irrigated Plots.* |
|---|---|---|---|
| | *Average of Talodi and Kadugli.* | *Ghati.* | *Average of Shendi, Moeis and Kober.* |
| Delta Webber ... ... | 29·6 % | 23.3 % | 26·4 % |
| Webber 10 ... ... ... | 28·0 % | 22·5 % | 26·5 % |
| Pedigree Dixie ... ... | 30·6 % | 26·0 % | 29·0 % |
| Pump Scheme ... ... | 27·6 % | 25·5 % | 26·4 % |
| Webber 38 ... ... ... | 26·5 % | 23·0 % | 25·3 % |

Last year the corresponding figures were as follows :—

| | *Sabonabi (close to Ghati Site and equally droughty.)* | *Average of Shendi and Kober.* |
|---|---|---|
| Delta Webber ... ... ... ... ... | 24·1 % | 30·8 % |
| Pedigree Dixie ... ... ... ... ... | 25·7 % | 33·2 % |
| Pump Scheme ... ... ... ... ... | 24·3 % | 29·5 % |
| Webber 38 ... ... ... ... ... ... | 22·5 % | 28·3 % |

The effects of locality and of seasonal differences at the same localities is strikingly brought out in the above figures, and the relative position of the varieties is confirmed. Of the varieties which were grown in both years, Pedigree Dixie always gives the highest result and Webber 38 the lowest. Delta Webber occupies the second highest position except under conditions of extreme drought.

Certain other interesting features were shown by an examination of the ginning percentage figures. In the case of the irrigated plots, the figures for out-turn all rose steadily towards the end of the picking season, whilst those for the rain-grown plots all showed an even more marked tendency downwards. The cause of the rise in the first case is almost certainly due to increasing boll worm infection, whilst the dropping curve characteristic of the rain plots is most probably associated with the increasingly dry conditions (cf. results from the exceedingly droughty plots at Ghati (1928–29) and Sabonabi (1927–28) ).

This association of low ginning out-turn with low soil moisture will be followed up further and may give an interesting side light on the problem of neppiness which is often a feature of considerable importance. Another interesting feature is that, although the ginning out-turn figures vary very considerably from place to place, yet the individual varieties tend to maintain their relative positions with considerable closeness.

This is well shown in the diagram (Fig. 1) on the following page.

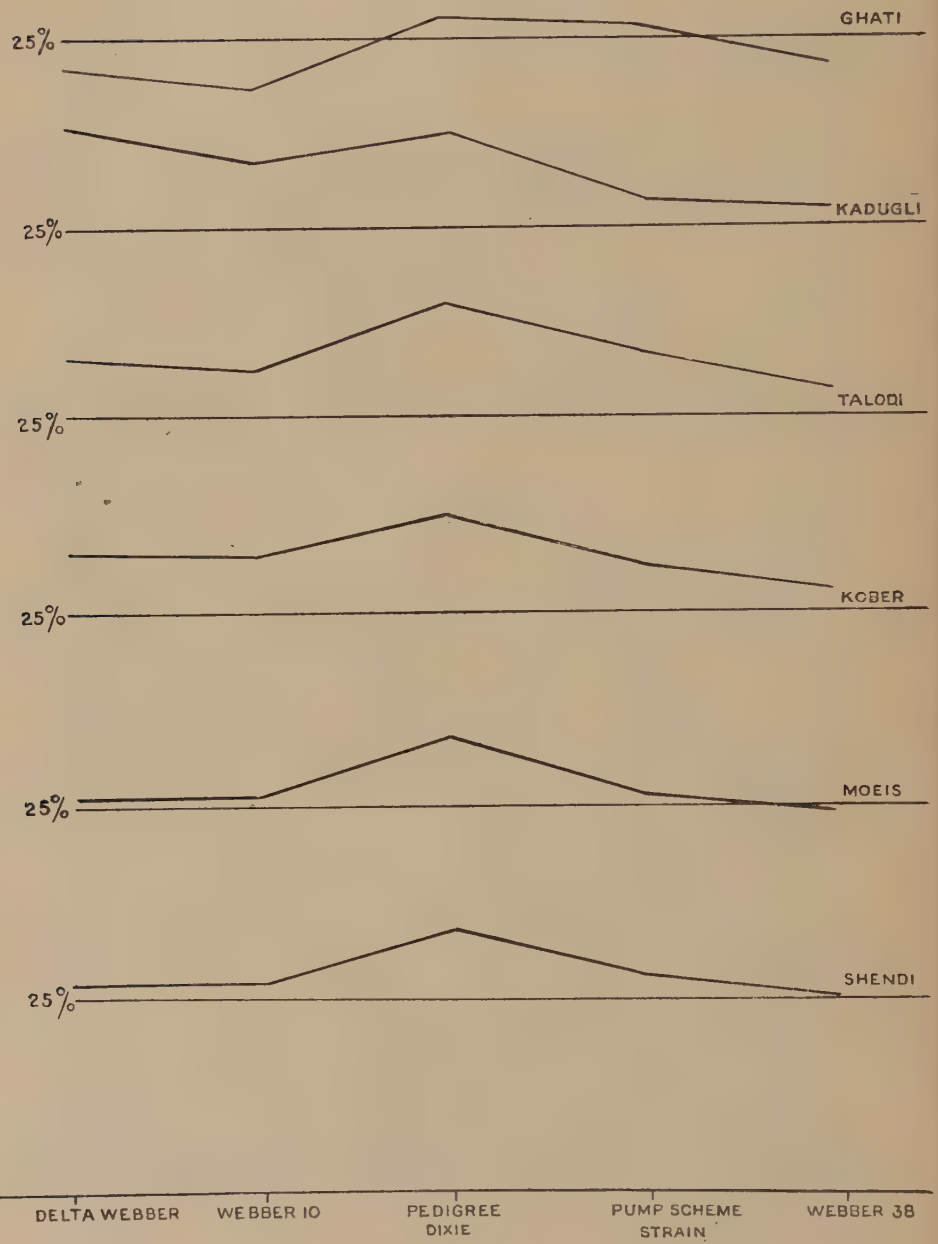
Developmental observations made during the growth of the rain-grown plots included a number of three-day flower counts at Talodi, so that deductions are rendered possible as to the relative susceptibility of the varieties to boll shedding. These and other conclusions as to the behaviour of the varieties are summarised below.

At Ghati the growing season ended very abruptly. Only two pickings were taken. Our data would seem to show that in this plot the quantity of the first picking was determined primarily by the intrinsic earliness of the varieties, and that of the second picking by the number of nodes which had been laid down prior to water-exhaustion.

FIG. 1.

AMERICAN VARIETY TESTS. GINNING OUT-TURN SHOWN IN PERCENTAGES.

(AVERAGE OF ALL PICKINGS)



*Delta Webber.*—Short-medium height; inclined, but not badly lodged. Sympodia longish and rather stout, starting at 5th–6th axil. Blackarm rather bad in early stages, otherwise medium or slight. Rather inclined to shed bolls at start and end of season, otherwise one of the least susceptible to shedding.

*Webber* 10.—Decidedly short, sympodia longish, medium and rather stout. Monopodial growths slight to medium. Very early. Sympodia start very well down (4th or 5th axil). Appeared to be the least susceptible to Blackarm of types tried. Boll shedding average in amount.

*Pedigree Dixie.*—Medium height, stout, strong-growing, but lax and sprawling. Rather much monopodia. Late in starting. Lowest sympodia usually in 6th axil, and often not effective until 7th or 8th axil. Blackarm susceptibility medium to rather high. Early boll shedding rather bad, otherwise average or better than average.

*Pump Scheme Strain.*—Distinctly tall and slender, with rather strong monopodial growth. Sympodia rather long and thin. Rather lax untidy growth. Somewhat late starter. Lowest sympodium variable—5th or 6th axils. One of the most susceptible to Blackarm. Boll shedding rather satisfactory throughout the season.

*Webber* 38.—Rather tall with spire-like habit, medium monopodial growth. Only slightly inclined to lodge. Sympodia usually start high, but at Talodi they frequently occurred in the 5th axil, this difference being accompanied by an improvement in earliness. Susceptibility to Blackarm about the same as for Pump Scheme Strain. Boll shedding satisfactory except at the end of the season.

The belt beds in the above plots were sown with other varieties under similar conditions of spacing, etc., with the idea of obtaining preliminary indications as to their yield and suitability to the districts. The belt beds at Sabonabi, and one of those at Ghati, failed entirely owing to drought. From the others the following indications were obtained :—

*Lone Star.*—This variety appeared to require rather abundant moisture. At Ghati and Kadugli it put up a very poor performance as regards yield, though at Talodi it gave an average result. It was tall and slender, and about medium early. Decidedly susceptible to Blackarm.

*Meade* (*E.C.G.C.*).—This was tried at Talodi and Kadugli only. It was a very late starter and gave very poor yields in both cases. Early shedding was severe and susceptibility to Blackarm high. In both cases it did relatively well in the 4th and 5th pickings, but fell away rapidly again after this phase.

### 4. Graders' and Spinning Tests.

As explained in last year's Report (1927–28), the results given here must necessarily refer to the crops grown a whole season earlier, and not to those which are discussed in detail in the rest of the present Report.

We are again indebted to the Director and staff of the Shirley Institute, to Messrs. Wolstenholme & Holland and to a number of spinning firms who have all kindly helped in the carrying out of the tests.

#### (*a*) *Egyptian-type Cottons from Shambat Variety Test* (1927–28 *Crop*).

These were submitted to grading tests only. The samples were taken from the 3rd picking of the varieties in the Standard Variety Test at Shambat. It had been intended to submit also a parallel series of samples from the corresponding plot at Wad Medani, but this later proved impossible. This is to be regretted as the Shambat environment normally tends to produce lint of rather coarse and rough type.

Varieties tested :—

Nahdah (Graders' valuations based on Pelion prices).
Sakel Bolland 8
Massey's Selected Domains
Sakel B/24
Sakel 186
Main Crop Gezira (Tokar Seed)
— All Sakels, and valued as such.

All the lots had been carefully picked and were classed as "Fully Good" in every case.

F.G.F. Sakel on the day of testing was quoted at 18.20d. No official quotation for Fully Good Sakel was published on that day, but the price was in the neighbourhood of 19.90d. Fully Good Pelion was standing at about 14.20d.

The results are summarised in the following table :—

| *Variety.* | *Staple (inches).* | *Valuation (pence per lb.).* | *Remarks.* |
|---|---|---|---|
| Nahdah ... ... ... | $1\frac{3}{8}$ | 14·50 | Strong. Very dark brown. Mod. fine and lustrous. |
| Sakel Bolland 8 ... ... | $1\frac{5}{16}$ | 18·75 | Strong. Light brown. Lacks lustre and fineness. |
| Massey's Selected Domains | $1\frac{5}{16}$ | 18·00 | Strong. Rather dark brown. Rough. Lacks lustre and fineness. |

| *Variety.* | *Staple (inches).* | *Valuation (pence per lb.).* | *Remarks.* |
|---|---|---|---|
| Sakel B/24 ... ... ... | 1⅜ | 19·00 | Strong. Rather dark brown. Lacks lustre and fineness. |
| Sakel 186 ... ... ... | 1 5/16 to 1⅜ | 18·75 | Strong. Light brown. Rough and lacks lustre. |
| Main crop ... ... ... | 1⅜ to 1½ | 20·00 | Very strong. Light brown. Fine and lustrous. |

The above valuations put the varieties in quite a different order to that obtained last year from a series of samples of the same varieties grown at Wad Medani.

(*b*) *Egyptian-type Cottons from Preliminary Variety Test, Shambat Experimental Farm* (1927–28 *Crop*).

The varieties tested were identical with those from the same plot in 1926–27. In addition, a sample of a new type from the Breeding Plots (provisionally designated " BBB ") was included for testing alongside with the varieties from the Preliminary Variety Test.

The result of the Lea tests and Ballistic tests are shown graphically in Fig. 2, together with the Graders' valuations. " Strength " is in all cases expressed by a figure representing the *product* of strength by count.

The varieties are grouped in the graph according to the nominal count to which each was spun in the test, a " control " sample, supplied by the mill, being included in each case.

The Graders' valuations are shown at the bottom of the graph, the price shown being that which would have been obtained if all samples had been graded as " Fully Good." The market quotations for F.G. Sakel, F.G. Pelion and F.G. Uppers on the same day are also given, and these price levels are indicated on the graphs by horizontal broken lines.

N.T. 25/24 is a real Uppers Type. Garofallou was priced by the Graders on a Pelion basis, but was spun against a Sakel control. The remaining varieties were all priced and spun as Sakels.

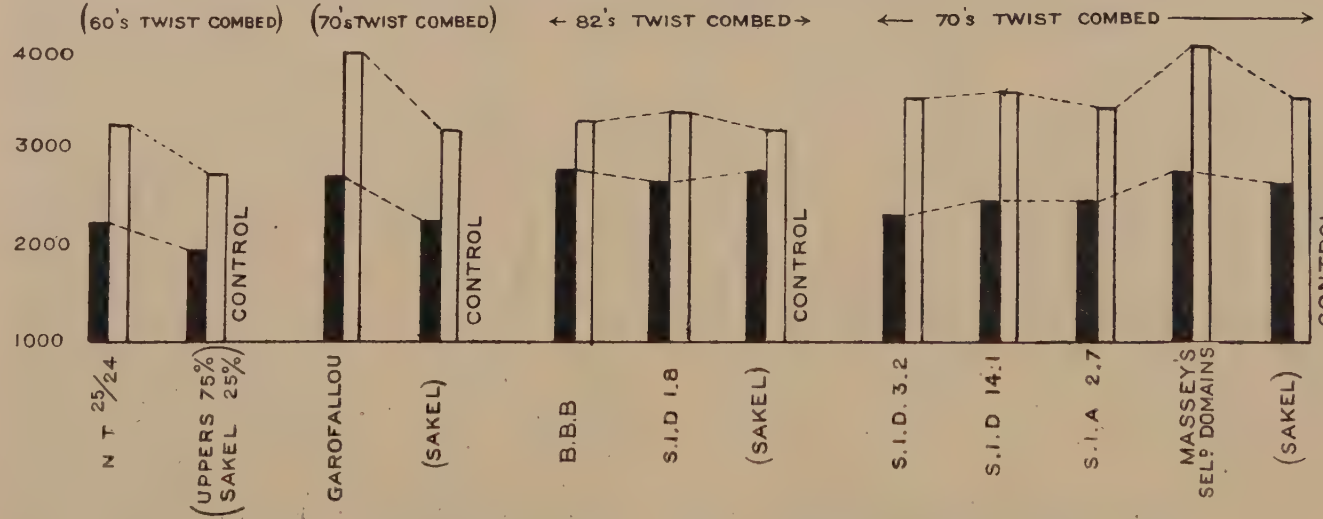
The outstanding features are the particularly good spinning results obtained with Garofallou and Massey's Selected Domains, despite the relatively low valuations given in both cases (thus confirming last year's results), and the very high valuation placed on " BBB." This last variety also did slightly better than the Sakel control in the matter of yarn-strength, but the comber waste came out at an extraordinary high figure—30·7%, against 23·1% for the control—thus making the use of this type practically out of the question.

# SHAMBAT EXPERIMENTAL FARM 1927/28

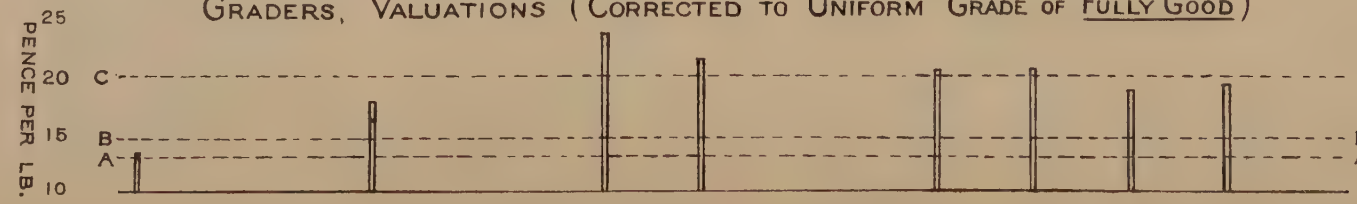
SAMPLES FROM PRELIMINARY VARIETY TEST & ONE OTHER SAMPLE ("B.B.B.") FROM NEIGHBOURING BREEDING PLOT.
(SAMPLES DRAWN FROM 3rd PICKINGS IN ALL CASES, EXCEPT "B.B.B." WHERE SAMPLE INCLUDES ALL PICKINGS FOR WHOLE SEASON.)

## YARN STRENGTH (STRENGTH X COUNT PRODUCT)

(LEA TESTS INDICATED BY BLACK COLUMNS BALLISTIC TESTS INDICATED BY WHITE COLUMNS.)




## GRADERS, VALUATIONS (CORRECTED TO UNIFORM GRADE OF FULLY GOOD)




NOTE :- A = FULLY GOOD UPPERS = 12·90; B = FULLY GOOD PILION = 14·20; C = FULLY GOOD SAKEL 19·90

Fig. 2.

The following additional information is taken from the Spinners' reports :—

*N.T.* 25/24.—Quite satisfactory. Waste losses considerably less than control. Strength tests good.

*Garofallou.*—Comber loss extraordinarily small. Strength excellent. Yarn much better in appearance than the control.

*BBB.*—Comber loss prohibitive. If double combed would probably spin very strong yarn at very fine counts.

*S.I.D.* 1. 8.—Very satisfactory—best of samples submitted in this group. Low waste. Would probably spin very well at 120's.

| | |
|---|---|
| *S.I.D.* 3.2.<br>*S.I.D.* 14.1.<br>*S.I.A.* 2.7.<br>*Massey's Selected Domains* | Behaviour satisfactory. Comber loss low (especially Massey's Selected Domains). Probably capable of 100's count. Massey's Selected Domains probably best. |

(*c*) *American Cottons from Standard Variety Tests at Shambat, Sabonabi and Talodi* (1927–28 *Crop*).

The material submitted for these tests consisted of five American varieties, grown in four different localities. Full details of the plots from which the samples were taken may be found in last year's Reports, and it is only necessary to state here that the Shendi and Moeis plots represented typical irrigated areas on one of the Pump Schemes in the Northern Sudan (practically no rainfall), whilst Sabonabi was situated at the northern limit of the rain-grown zone and suffered very severely from drought, and finally, that the Talodi plot may be taken as typical of a large portion of the Nuba Mountains district, where cotton is now being developed on a large scale under conditions of moderate but sufficient rainfall. Only two pickings were taken at Sabonabi owing to the early curtailment of the crop by drought. Eight or nine pickings were taken during the course of the season at the other localities. Samples from one picking only from each of these districts were submitted to spinning tests, but additional samples, covering a wider range of pickings, were examined by the Graders.

The Graders' reports are summarised in the following table. The figure for price given in the table represents in every case what the value would have been *if all the samples had been graded as "Strict Good Middling."* The official quotation for S.G.M. American on the day of the examination was 11·11 pence, Middling American on the same day being 10·55d.

| | | | *Columbia* 40. | *Delta Webber.* | *Webber* 38. | *Pump Scheme Strain.* | *Pedigree Dixie.* |
|---|---|---|---|---|---|---|---|
| SHENDI | 2nd picking | Staple ... | 1 3/16 (little irregular) | 1 3/16–1 1/4 | 1 3/16–1 1/4 | 1 1/8 | Good 1 1/8 |
| | | Strength ... | Medium | Strong | Strong | Medium | Strong |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | S.G.M. | G.M.toS.G.M. |
| | | Valuation | 13·75 | 14·50 | 14·75 | 12·00 | 12·63 |
| | 4th picking | Staple ... | Full 1 1/8 | Good 1 1/8 | Full 1 1/8 | 1 1/8 | 1 1/16–1 1/8 |
| | | Strength ... | Medium | Weak to Medium | Medium | Rather weak | Rather weak |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | G.M. | G.M. |
| | | Valuation | 12·50 | 12·25 | 13·00 | 11·50 | 11·25 |
| MOEIS | 2nd picking | Staple ... | Full 1 1/8–1 3/16 | 1 3/16 | 1 3/16–1 1/4 | Good 1 1/8 | Good 1 1/8 |
| | | Strength ... | Medium | Medium–Strong | Strong | Strong | Strong |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | S.G.M. | G.M.toS.G.M. |
| | | Valuation | 13·25 | 14·25 | 15·00 | 12·75 | 12·50 |
| | 5th picking | Staple ... | 1 1/8 with short | 1 1/8–1 3/16 | Full 1 1/8 | Good 1 1/8 | Good 1 1/8 |
| | | Strength ... | Weak | Medium | Weak to Medium | Medium | Medium |
| | | Grade ... | G.M. | G.M. | G.M. | G.M. | Barely G.M. |
| | | Valuation | 11·25 | 12·75 | 12·00 | 12·25 | 11·65 |
| TALODI | 3rd picking | Staple ... | Full 1 1/8 | Full 1 1/8 | 1 1/8–1 3/16 | 1 1/8 with short | 1 1/8 |
| | | Strength ... | Medium–Strong | Medium–Strong | Medium | Weak–Medium | Strong |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | G.M. | S.G.M. |
| | | Valuation | 12·65 | 12·65 | 12·75 | 11·50 | 11·75 |
| | 6th and 7th pickings | Staple ... | Good 1 1/8 | 1 1/8 with short | Full 1 1/8 | 1 1/16–1 1/8 | 1 1/16–1 1/8 |
| | | Strength ... | Medium | Weak | Weak to Medium | Medium | Medium |
| | | Grade ... | S.G.M. | G.M. | G.M. | S.G.M. | S.G.M. |
| | | Valuation | 11·75 | 11·25 | 11·75 | 11·00 | 11·00 |
| SABONABI | 1st picking | Staple ... | 1 1/8 | 1 1/8 | Full 1 1/8 | 1 1/8 | 1 1/8 |
| | | Strength ... | Very weak | Very weak | Weak to Medium | Medium | Very weak |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | S.G.M. | S.G.M. |
| | | Valuation | 10·75 | 10·75 | 12·00 | 11·50 | 10·75 |
| | 2nd picking | Staple ... | 1 1/16–1 1/8 | 1 1/16–1 1/8 | Full 1 1/8 | 1 1/8 | 1 1/16 |
| | | Strength ... | Very weak | Very weak | Medium | Medium | Very weak |
| | | Grade ... | S.G.M. | S.G.M. | S.G.M. | S.G.M. | S.G.M. |
| | | Valuation | 11·00 | 11·00 | 12·25 | 11·50 | 10·50 |

An examination of this table shows, first of all, a falling off in grade and staple from earlier to later pickings, and secondly a steady drop in staple length from "irrigated" conditions through "medium rainfall" to "light rainfall" conditions.

In all except the Sabonabi plot, the first three varieties usually stand at a useful premium compared with the Pump Scheme Strain, which is the type at present most widely grown in this country. Pedigree Dixie, which is admittedly a shorter stapled cotton than the others, averages out at about the same price as Pump Scheme for these plots.

The extremely droughty conditions at Sabonabi have had a notable effect on the strength of the lint obtained, and here Pump Scheme cotton has obtained a better price than all its competitors except Webber 38. Too much importance, however, should not be attached to the Sabonabi results, as cotton-growing would not normally be attempted with so deficient a rainfall.

Omitting this plot, the varieties which have given the most consistently good results in these tests are Webber 38 and Delta Webber. The results obtained from spinning tests with these varieties are shown diagrammatically in Fig. 3 (p. 188). It will be noted that in the Lea Tests all the varieties except Pedigree Dixie gave better results than the control, despite the fact that an Uppers mixing was used for this purpose instead of ordinary American. The same is true in the case of the ballistic tests, but here, in one case, Pedigree Dixie came out better than the control. This emphasises the high standard of quality of these cottons in general.

In our last year's Report more importance was given to the results of the ballistic test than to those from the Lea test. If this principle is again followed it will be seen that the three first varieties have all given results markedly superior to those obtained from Pump Scheme, and Pedigree Dixie. In the case of Pump Scheme, however, this is only partly supported by the Lea Tests. This agrees with the experience obtained with the earlier pickings from the previous season's crops (see " Reports from Experiment Stations, 1927–28 "). The rapid deterioration of Pump Scheme in later pickings, compared with the other varieties, which was noted in the previous Report, should be borne in mind in assessing the present results, which refer to early pickings only.

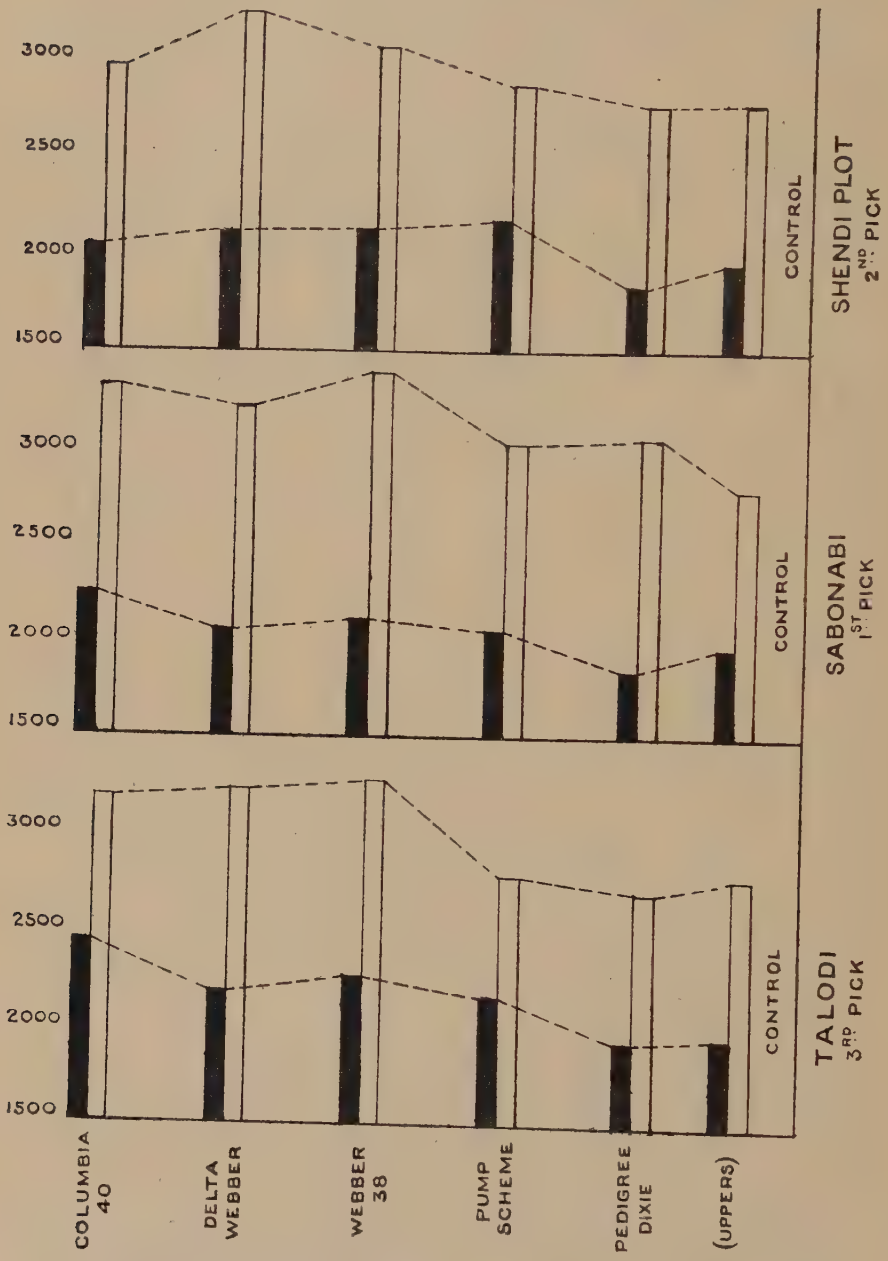
A tendency to neppiness and lumpiness was noted in all the yarns, but the degree to which this occurred did not appear to vary regularly with the different localities. For instance, Delta Webber and Pump Scheme were both reported as " lumpy and neppy " when derived from Shendi, and both as " distinctly better " when from Talodi, but at Sabonabi Delta Webber gave a neppy yarn, whereas Pump Scheme was quite fairly satisfactory. Again, Columbia 40 and Webber 38 were satisfactory when grown at Shendi, but " lumpy and neppy "

FIG. 3.

# AMERICAN VARIETY TESTS 1927/28

## YARN STRENGTHS AS MEASURED BY STRENGTH X COUNT PRODUCTS

(ALL SAMPLES SPUN TO 40$^{s}$ RING TWIST)




NOTE { RESULTS OF LEA TESTS INDICATED BY BLACK COLUMNS
DO BALLISTIC TESTS DO WHITE COLUMNS

from both Talodi and Sabonabi. It is interesting to note in this connection that the waste losses from Shendi and Sabonabi were in all cases rather higher than the control, whilst those from the Talodi crop were, without exception, rather lower.

The Spinners' Report shows that Pedigree Dixie tended to produce a nice even yarn, but it is stated that "the good appearance of this yarn is quite outweighed by poor strength."

The samples from Shendi gave the highest lea strength, whereas those from Talodi gave the highest values for the ballistic test. Those from Sabonabi, which suffered badly from drought, gave the poorest results in all respects.

Figures for the yields of these three plots may be found in last year's Report, as also figures for ginning out-turn at Shendi and Sabonabi.

Making use of this information, it is possible to obtain figures representing the actual cash value per unit "bed" for each of these varieties. This is done below, using corrected yields.

No figures for ginning out-turn were available from Talodi for 1927–28, but values for four of the varieties then grown have since been obtained and are made use of below, the results being shown in italics in order to emphasise that the figures used for ginning out-turn in this case belong to a different year.

Estimate of Cash Return per Unit Sub-Plot in 1927–28, Based on Available Figures for Yield, G.O.T. and Value of Lint.

| | *Shendi.* | *Sabonabi.* | *Talodi.* |
|---|---|---|---|
| Columbia 40 ... ... ... ... ... | 438·0 | 55·0 | — |
| Delta Webber... ... ... ... ... | 507·5 | 77·1 | *352·0* |
| Webber 38 ... ... ... ... ... | 413·2 | 80·6 | *290·5* |
| Pump Scheme Strain ... ... ... | 487·5 | 78·7 | *296·5* |
| Pedigree Dixie ... ... ... ... | 453·9 | 68·7 | *355·6* |

No estimate can be made for Colombia 40 at Talodi, as this variety was not grown again last year, so that no figures at all are available for its ginning out-turn at that station.

The figures given in the table, though giving the most exact information available as to the relative cash values of the different varieties at the particular stations shown, must still be accepted with reserve. As pointed out in last season's Report, Delta Webber was unduly favoured in the matter of yield at the Shendi plot, and it is probable that Pump Scheme Strain was also accidentally favoured at Sabonabi. Pedigree Dixie gave the highest cash return at Talodi, but its use cannot be recommended in view of its markedly poorer spinning performances in two consecutive years.

### 5. Developmental Observations on Cotton Plants.

#### (*a*) *Observations on Plants Grown in Boxes and Investigations on Bud Formation and Development.*

Five Sakel plants were grown in box-culture under conditions of soil and root space comparable to those in the experiments carried out in previous years. The date selected for sowing was mid-September.

The usual observations were made and records kept of the rate of germination of seeds and of the rate of growth and production of flowers, fruiting branches, etc. The lowest sympodium was produced in these plants at the 11th or 12th node, representing a " delay " of four or five nodes due to " heat suppression," caused by high temperatures during the period October 11th–26th.

" Physiological " shedding seems to have been much more severe and to have set in earlier than in previous years. This is in accordance with general experience throughout the Experimental Farm plots, as described in the introductory portion of this Report. Both buds and whole sympodia or terminal portions of sympodia were shed, and the result of these losses was clearly discernible later in the shortness of the fruiting branches, which usually carried only two or three nodes by the time the bolls began to open, instead of the more normal number of four or five, which one expects to find in the main fruiting zone of these box culture plants.

From December onwards, bollworm attack became very serious on these plants, and bolls opening in early February were largely damaged and abnormal. Later in February the infestation had increased to such a degree that practically no bolls were able to ripen at all. Under these circumstances the data obtained from box plants this season are naturally very meagre.

Detailed examination of these plants and of other cotton plants growing in the open has brought out certain interesting relations between the formation and development of buds and certain well defined " zones " on the plant.

The most interesting conclusion reached relates to the way in which the plants react to excessively high temperatures so as to bring about the observed suppression of fruiting activities. It seems clear that in the lower part of the fruiting zone (from the seventh axil upwards in the case of Sakel cotton) the non-appearance of sympodial branches is due chiefly to their *conversion into vegetative buds*, which usually grow out into small green tufts (" Monopodial tufts ") or into fully developed monopodial shoots, but which sometimes remain as small, barely-opened buds. In a very few cases the buds remain quite dormant. Once the zone has been reached where the plant has found

it possible to produce sympodia at all, the absence of a sympodial branch at a node is almost always due to complete abscission of the young branch, though an occasional case of " conversion " was found in such situations.

Other conclusions relate to the number and position of the buds in the leaf axils and serve to emphasise the existence of a real difference in functional capability between the lower " monopodial zone " and the upper " sympodial zone " of the cotton plant.

The homology of the " monopodial tufts," so frequently observed in this country, with true monopodial shoots appears to be established, and the interesting fact has been noted that monopodial tufts are borne in the centre-bud position in the lowest leaf axils of the plant, then, at a later stage, in the exaxillary position when they are taking the place of sympodial branches ( by " conversion ") in the lower fruiting zone, and later still, in the central position again. This second change takes place in each plant at the point where climatic conditions cease to inhibit the production of sympodia. A single case only was noted where a " converted " sympodial shoot (in the exaxillary position), due no doubt to a temporary return of unfavourable conditions, had arisen alongside a partly developed bud in the central position.

(*b*) *Root Development and Soil Studies.*

The study of the root growth of cotton has also been continued and extended along lines similar to those followed in previous years.

A number of plants of Tanguis cotton, growing in the Breeding plot at Shambat, were dug up and their root systems examined. This variety had, in the last two seasons, attracted attention by its very stiff, erect growth and vigorous habit, which contrasted favourably with that of Sakel and Sea Island types under Sudan conditions, and it was thought desirable to see how far this habit was explained by the root system.

The root systems of these plants were found to be very copious, with stout tapering laterals of great strength and thickness and freely branched. Depth penetration was, however, poor, and in no case had the roots exceeded 54 cms. in depth (the lowest limit of the better surface soil). It thus has poor penetrative power, in the same category as Sakel and Upper Egyptian. Its lateral root system was copious and well developed throughout the upper 30 cms. of soil, and was of the type of Sea Island, though of even greater vigour, and quite adequate to the excellent top growth.

An attempt has been made during this season to study the growth of root systems " in plan " in the soil, as well as " in elevation." It was felt desirable to know, firstly, how the shallow rooting habit of cotton plants in this country might be affected by interculture

operations, and, secondly, to what extent crowding occurred and how thoroughly the soil was worked by the roots of cotton plants at our present spacing of 90 × 50 cms.

Accordingly a sample block of 2 metres by 1½ metres was selected, containing three ridges, each with four holes occupied by plants. Full data were taken of the plants, the tops of which were then cut off close to the ground, the stumps being tied to supporting stakes. The soil was then removed in layers of ten cms. depth, down to sixty cms. A scaffolding was erected over the block of plants, with a platform at a height of 15 feet, on which was mounted a camera, arranged to photograph vertically. At each stage in the excavation, the roots exposed were whitened and a photograph taken. The roots displayed confirmed the findings of previous studies as to depth of penetration, importance of three soil zones, etc.

The soil was found to be fairly thoroughly interpenetrated by the roots, but could hardly be described as crowded. Inter-culture between the rows to a depth greater than 10 cms. would appear likely to cause considerable damage to large shallow laterals, unless started sufficiently early and carried on at sufficiently short intervals to drive the main lateral branches well down into the soil. There is quite an appreciable root development in the ridges themselves, and cultivation with hand hoes between plants along the ridges requires to be done with caution. The soil below the furrows is irregularly worked by the roots, and, frequently, large laterals from several plants around seem to make for certain centres, suggesting a scramble for points of better quality in regard to nutriment, water, or opportunities for depth penetration. The presence of long laterals running over into neighbouring ridges, or up the ridge or furrow past the sites of two or more neighbouring plants is notable.

Apart from the above investigations, work on this subject has largely been directed to an attempt to determine the exact nature of the unfavourable features of the hard layer of soil underlying the surface soil, in hopes of, perhaps, devising measures to improve it directly, or of obtaining guidance for the selection of races more competent to deal with it.

It has been shown that the soil from this " bad " zone when freshly dug and filled into wooden boxes affords a very bad medium for the growth of both American and Sakel cotton ; the surface soil giving good normal, and the deep zone poorish intermediate growth. After one year's regular watering and the growth of a crop of cotton plants in the boxes, the character of the soil is considerably changed and the effect of soil profile modified and smoothed out. The growth of a second crop of cotton, sown in the same boxes of soil without disturbance

other than surface cultivation, was fair to medium and very similar in the soil from all three zones. The appearance, colour and cloddiness of the soil taken from the middle layer was also modified to some extent in the direction of uniformity with the surface zone.

Analysis showed that the amount of free salts was reduced markedly throughout and its maximum in the middle zone diminished in intensity, compared in each case with corresponding determinations for the same soils when freshly dug. The compaction of the lumps, as measured by their "apparent density," was also reduced throughout, and the maximum in the middle zone again lowered in relative intensity, giving a flatter curve for the soil profile.

(*c*) *Observations on Shedding.*

An experiment was carried out on lines similar to those employed last year.

A "shedding trough" was fixed up between two lines of Sakel plants, grown at field-crop spacing, and the sheddings were brushed out each day, and classified according to size and character.

The results were put out graphically, the resulting curve being very different in character from that obtained from the previous year's data. In the previous season bud-shedding did not commence until early October, and, except for a temporary "peak" in mid-October, rose more or less steadily to a maximum in the last week of November. In the season just past, bud-shedding was already bad by the last week in September and continued at a high level, with something of a "peak" at the end of October, until it commenced to slack away about mid-November.

In view of this great difference shown by the bud-shedding curves for the two seasons, it is of considerable interest to find that the *proportion* of buds of different sizes which fell off was very similar in both cases.

The percentages of buds shed in the different size-classes are shown in the following table :—

*Width in millimetres across bracteoles of the buds shed.*

| | 0–5 | 6–8 | 9–12 | 13–16 | 17–24 | Over 24 | |
|---|---|---|---|---|---|---|---|
| Percentages of total sheddings | 44 | 28 | 11 | 8 | 8 | 1 | 1927–28 |
| | 46 | 24 | 14 | 9 | 6 | 1 | 1928–29 |

This fixity in the proportions in which buds of different ages are shed accords well with Egyptian experience, though the actual percentages recorded in that country differ considerably from those now given for Shambat.

The severity and time of occurrence of bud-shedding this year fitted in very well with the observed abnormalities in flower and boll production, and may be taken to be the major factor concerned in

bringing about the reduction in yield. If the indications obtained are correct, it would seem that flower production in this region is influenced chiefly by shedding of buds 0·8 millimetres in diameter (measured across the bracts), taking place about two weeks prior to the time at which those buds would have opened as flowers.

In general, it may be said that the period of heaviest bud shedding (mid-October to mid-November, 1928) coincided with the period of specially low humidities, but it has not so far been possible to connect individual short " dry " periods with corresponding periods of increased shedding.

Very heavy leaf-shedding took place during the season 1928–29, the maximum occurring in December, instead of in January as in the previous year. This early maximum was doubtless connected with the vigorous burst of young growth and flowering which took place in December, the first phase leaves being thrown down at the same time as the new ones were expanded higher up on the stems.

(*d*) *Observations on Seed-development and Boll-opening.*

In our last year's Report attention was drawn to the prevalence of " blind " seeds, that is, seeds whose development has been arrested at a very early stage and which, typically, bear only short greenish fuzz and no lint, and also to the faulty opening of bolls, shown by all cottons of *peruvianum* or *barbadense* type in this country, but particularly in evidence in the case of Sea Island plants.

An attempt has been made in the season just past to obtain information as to the reason for this " blindness," and to discover whether deficiency of fully developed seeds is connected with the bad opening of bolls.

Two series of experiments were carried out, the plants being grown in boxes in both cases. In each series two varieties were included, namely, Sakel and a (fixed) hybrid between Sakel and Sea Island which had been found in the previous season to be specially liable to bad boll opening.

The first series was sown in August, and the boxes were given varying amounts of water, as being the most likely factor to influence boll opening. The majority of the plants were completely enclosed in mosquito-netting in order to prevent destruction of the bolls by boll worms, but a certain number of plants were left unprotected as " normal " controls. The netting in this particular case proved to be unnecessary, as the plants were practically unaffected by boll worm, due probably to their isolated position amongst buildings, and to the relatively early season during which they ripened. The bolls were picked as they opened, the degree of opening of the valves being

recorded and marks given for the " pickability " of the cotton. At the same time a record was compiled as to the number of fully developed and blind seeds in each lock.

As an experiment on boll opening, the series gave disappointing results, as the boll opening of the hybrid plants was almost uniformly good. The reason for this is very hard indeed to suggest, but it seems probable that the freedom from insect pests which these plants enjoyed must be partly responsible. On the other hand, individual cases of bad opening certainly did occur in bolls which were quite free from such pests. No evidence was obtained that the proper opening of bolls is interfered with by deficiency in water supply. Slight indications were obtained of a correlation between bad boll opening and a low number of developed seeds per lock, but wide discrepancies occurred.

The most interesting indication which emerged from these records was that abundant water supply was conducive to a high rate of seed setting and *vice versa*. The netted plants set seed as well as those in the open, so it would appear that the presence of " blind " seeds cannot be attributed directly to the absence of fertilising insects, as had previously been thought to be the case.

The following figures are given for three " hybrid " plants, but the results need confirmation from further observations :—

| *Treatment.* | *Total Number of Locks.* | *Average Number of Seeds per Lock, including both Fully-Developed and Blind Seeds.* | *Percentage of Developed Seeds to Total.* | *Percentage of Blind Seeds to Total.* |
|---|---|---|---|---|
| Netted plant (Much water) | 143 | 6·33 | 80·7 | 19·3 |
| Exposed plant (Water as required) | 99 | 5·08 | 76·2 | 23·8 |
| Netted plant (Little water) | 56 | 5·72 | 67·5 | 32·5 |

In the second series of experiments two Sakel plants and two hybrid plants were grown in boxes in the open. The sowing was made in mid-November, and all boxes were treated alike as regards water. The plants grew well but were so heavily infested with boll worms (only about 2% of bolls escaped) that conclusions as to bad boll opening due to other causes are almost impossible to make. The series, however, gave a lot of information on various points. Last year certain cases were noted where bolls actually shrank in size. A considerable number of boll-measurements were made during the season just past, and the following conclusions have been tentatively arrived at :—

(i) Shrinkage is not invariable, but very frequent both in Sakel and in Sea Island hybrids. In none of the cases observed, except two (both

of which shrank $\frac{1}{2}$ mm. only), could the bolls be described as entirely healthy. In other cases either boll worm was present or the seeds were somewhat shrunken and the lint soft and discoloured. On the other hand, the presence of boll worm was not always accompanied by shrinkage.

(ii) Shrinkage occurs at various stages, and takes place over either a long or short period of time.

(iii) The only case where shrinkage occurred before the 15th day was followed by early shedding. Shrinkage was most frequently recorded between the 30th and 50th days.

(iv) It varied in amount from $\frac{1}{2}$ mm. to 4 mm. in diameter. If very marked in degree it was usually followed by shedding, but not invariably.

(v) Bad boll opening occurred in cases of little or no shrinkage as well as in cases of much shrinkage.

(vi) It does not appear to be connected with the formation of the abscission layer.

In addition to compiling these records, a considerable number of buds, flowers and bolls were treated in various ways and the results noted. The following are some of the more interesting conclusions : —

(i) No evidence was obtained of improvement in seed-setting as the result of artificial selfing or crossing.

(ii) Complete removal of one or more stigma lobes did not prevent fertilization taking place within the loculi corresponding to the amputated stigmata, but the number of fully developed seeds was reduced, the deficiencies being represented by " blind " seeds.

(iii) When the greater part of all three stigmatic surfaces was cut off, leaving only a very small area of papillated surface, satisfactory fertilization still took place.

(iv) Slight evidence was obtained that bolls shaded from direct overhead sunlight opened better than those not so shaded.

(v) Flowers which opened during a day of sandstorm set seed in a normal manner.

These and similar experiments will be continued as time permits.

### 6. Publications.

A paper on " Cotton Variety Testing in the Sudan," explaining the system of layout and the methods of working up the resulting data, which are employed by the Plant Breeding Section, was read before a meeting of Agricultural Research Workers, held at Wad Medani in December, 1928. This paper, along with others read at the same meeting, will shortly be published by the Sudan Government.

(*Included by courtesy of the Uganda Government.*)

# UGANDA

## REPORT ON COTTON EXPERIMENTS, SERERE STATION, SEASON 1928-29

BY

G. W. NYE, *Cotton Botanist*, AND H. R. HOSKING, *Assistant Cotton Botanist.*

SUMMARY.

1. *Meteorological.*—The chief climatic feature of the 1928–29 season was the very dry period from November onwards ; the rainfall for the year being ten inches below the average. The drought conditions caused the plants to go off rapidly, and resulted in the absence of a second flowering peak.

2. *Progeny Rows and Selection Work.*—Progress was made with re-selections from existing strains—the S.G. 27 group being the most promising. Several small plots of newly imported American varieties were grown, but the only promising type was Acala, from which selections were made.

3. *Small Bulk Increase Plots.*—Four segregated plots were sown, and of these S.G. 27 and S.G. 23.8 were selected for further trial.

4. *Bulk Increase Plots.*—The main crop at Serere and at Simsa was the S.G. 29 strain which gave good yields considering the drought conditions. This strain is a definite advance on N. 17 and it has been selected for planting up the new Milondo " seed farm " area in the forthcoming season.

5. *Variety Trials.*—These were conducted as usual at various centres in the Eastern Province ; the results showed that S.G. 29 is quite equal to N. 17 in yielding powers and that S.G. 15 is definitely a low-yielding strain. In the Serere trial S.G. 7 gave a significantly higher percentage of low quality cotton than the other strains in the test.

6. *Sowing Date and Spacing Experiment.*—This again showed the advantage, under Serere conditions, of early planting. No differences were obtained between the various spacings tried, but the percentage of poor cotton was distinctly higher at the close spacings than at the normal or wide ones.

7. *Insect Pests and Fungoid Diseases.*—Stainers and jassids were prevalent, the former being especially bad at Serere, where hand picking on the progeny rows was resorted to.

Black Arm did a considerable amount of damage, and in parts of North Teso fully 50% of the crop was lost.

8. Reports received, both on the samples sent from Serere for spinning tests, and also on the main crop, indicate that the climatic conditions brought about a deterioration in the quality of the lint as compared with the previous season.

Mr. Hosking was appointed to the post of Assistant Cotton Botanist in August, 1928, and commenced duty at Serere on October 1, 1928.

Mr. Nye, Cotton Botanist, went on leave at the beginning of April, 1929.

## Season.

The 1928-29 season was again very dry as the following table shows:—

TABLE I.

Rainfall.

| *Month.* | *Monthly Means 1921–27 inclusive. Inches.* | 1928–29. *Inches.* | *No. of Days of rain per month.* 1928–29. |
|---|---|---|---|
| January ... ... ... | 0·72 | 1929 { 0·20 | 3 |
| February ... ... ... | 2·38 | 1929 { 0·31 | 3 |
| March ... ... ... ... | 4·32 | 1·15 | 9 |
| April ... ... ... ... | 8·33 | 11·49 | 20 |
| May ... ... ... ... | 6·14 | 4·85 | 21 |
| June ... ... ... ... | 4·91 | 3·67 | 16 |
| July ... ... ... ... | 5·04 | 1928 { 2·95 | 11 |
| August ... ... ... | 6·55 | 1928 { 5·28 | 22 |
| September ... ... ... | 5·63 | 5.36 | 10 |
| October ... ... ... | 5·03 | 4·88 | 15 |
| November ... ... ... | 4·78 | 4·07 | 12 |
| December ... ... ... | 1·00 | 0·39 | 4 |
| Totals ... ... ... ... | 54·83 | 44·60 | 146 |

The 1927–28 season had a total rainfall 9.00 inches below average, and the 1928–29 season was 10.23 inches below average. The effect of this dry weather will be discussed later.

The planting months of May, June, July and August showed this season a higher relative humidity and a lower average soil temperature than the other eight months of the year.

From a consideration of the meteorological data, the months of May and June appear to be the most favourable for cotton planting. The results of the Sowing Date Trial for the last three seasons support this idea.

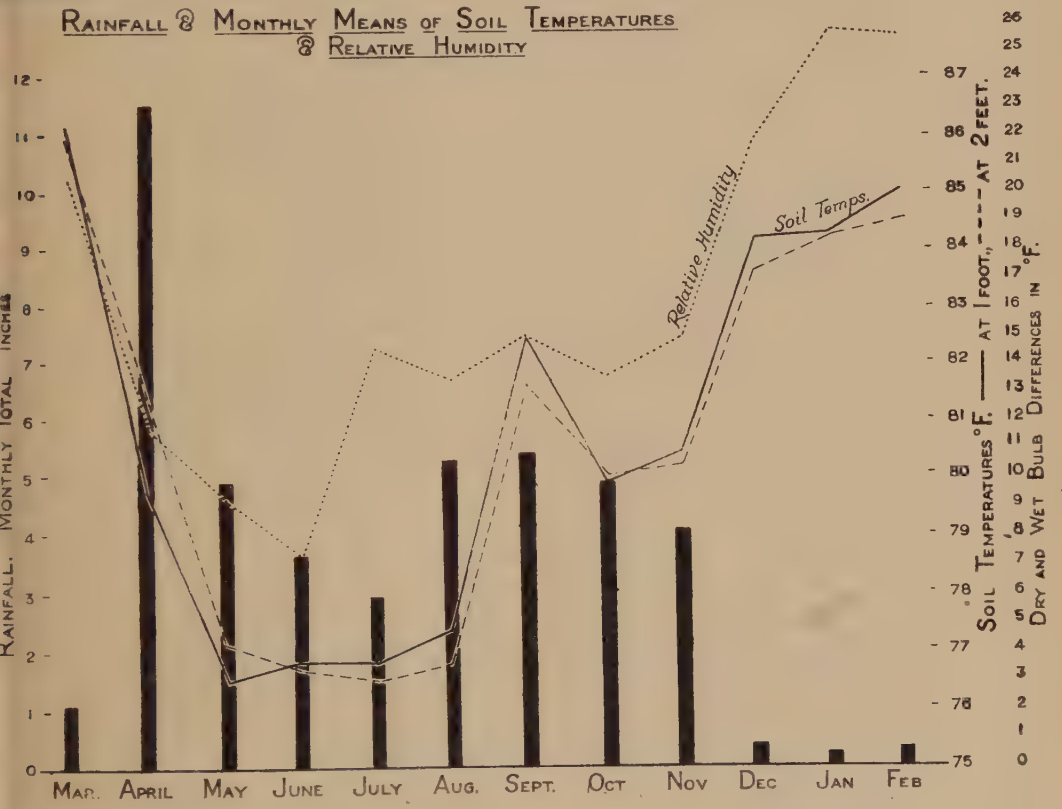
Diagram 1 gives a graphical representation of the monthly rainfall and of the mean monthly humidity and soil temperature for 1928–29 season.

The chief result of the long hot dry period from October to February was the absence of a second peak in the flowering curves.

DIAGRAM 1.

SERERE — 1928-29 SEASON.

RAINFALL & MONTHLY MEANS OF SOIL TEMPERATURES & RELATIVE HUMIDITY




## THE PROGENY ROWS.

These were sown on July 10 and the plants were watered by hand owing to the lack of sufficient rain. In this way a satisfactory stand was obtained. Even so, a fair number of blanks had to be re-sown.

On the whole the results were disappointing, as there were fewer "sound" bolls (*i.e.*, bolls with all locks free from stain and fully developed) than usual. Stainers appeared early in the season and

seriously threatened the crop. However, they were eventually controlled by hand picking, but there is no doubt that they were responsible for the large number of stained and diseased loculi. "Black Arm" was quite serious, and at one time it looked as if the rows were going to be decimated, but after a certain number of plants had been killed the remainder showed a good recovery. Jassids were fairly prevalent, and it was easy to pick out the susceptible strains. All the re-selections from S.G. 15 were badly attacked, while S.G. 56 (a re-selection from S.G. 35.10) was particularly free from leaf discolouration as compared with the adjacent rows.

The re-selections from S.G. 27 were very promising by reason of their lint length and weight per boll. One very noticeable feature of the season was the enormous variation in lint length in individual plants. One Okra-leaf plant gave lint varying from 24 mm. to 37 mm. in successive pickings. Another plant showed 18 mm. for one of its earliest bolls and 32 mm. for one of the last to be picked. The weight of lint per boll was also disconcertingly variable on individual plants.

The weight of lint per boll and the total number of "sound" loculi produced give a good estimate of the actual yield of a plant, while the total number of bolls produced only gives an idea of potential yield. It is unfair to take only the sound bolls into consideration when judging the merits of a plant, as it has been noticed that a great many bolls are stained (or aborted) in only one loculus.

Three individuals produced approximately 0.16 lbs. of lint each. Figures of this sort must be used with discretion, but it is of interest to compare this figure with the 0.19 lbs. of lint produced by a single plant growing in the main crop of S.G. 29. This plant must have produced nearly a quarter of a pound of lint during the season as it was not selected until a certain number of bolls had been formed; these were of course removed when selfing was started.

The two rows S.G. 27.15.10 and S.G. 27.15.13 are perhaps the most promising. Each row consisted of 35 plants and the number of flowers per plant, the number of bolls per plant, the lint length per plant, the seed weight per boll and the lint weight per boll were divided into suitable classes and plotted in the form of frequency diagrams. S.G. 27.15.13 gave more regular curves for the number of flowers per plant and the number of bolls per plant than S.G. 27.15.10, with a lower percentage of shedding. S.G. 27.15.13 also had a higher average lint length than S.G. 27.15.10, and as regards seed weight per boll and lint weight per boll, while both show great variation, S.G. 27.15.13 had the higher average of the two.

TABLE II.

SUMMARY OF CHARACTERS OF SOME PROMISING STRAINS GROWN IN PROGENY ROWS.

| *Strain.* | *Total Bolls per Plant.* | *Sound Bolls per Plant.* | *Total Loculi per Plant.* | *Loc. No.* | *Seeds per Boll.* | | *Seed Weight per Boll. Gms.* | *Lint Weight per Boll. Gms.* | *Lint Length Mms.* | *Lint Index. Gms.* | *Ginning Percentage* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Good.* | *Motes** | | | | | |
| S.G. 27.15.10 ... | 41·1 | 7·9 | 84·0 | 4·0 | 32·3 | 2·7 | 2·92 | 1·48 | 30·8 | 4·6 | 33·6 |
| S.G. 27.15.13 ... | 40·7 | 9·7 | 92·0 | 4·1 | 31·2 | 2·9 | 3.24 | 1·74 | 30·9 | 5·6 | 34·9 |
| S.G. 29. 1. 7 ... | 34·7 | 8·8 | 75·0 | 4·0 | 31·8 | 1·9 | 2·97 | 1·66 | 30·3 | 5·2 | 35·8 |
| S.G. 29. 9.14 ... | 31·5 | 7·3 | 74·0 | 4·1 | 30·4 | 2·7 | 2·95 | 1·52 | 30·1 | 5·0 | 34·0 |

4-Loc. Bolls only used for the Boll and Lint Characters.

* Mote=undeveloped or aborted ovule.

Both these strains have been selfed for three successive generations.

The row S.G. 29.1.7 (also selfed for three generations) gave a distinctly bimodal curve for lint weight per boll. Two plants in the row S.G. 29.9.14 showed green fuzz. This character appears to be very persistent and hard to select out.

### Varieties.

Three rows of each of the following varieties were grown for observation purposes :—

Meade, Sunflower, Allen, Acala, Kasch, Mebane, Arizona, Nyasaland (S.G. 29), Bancroft, Webber Upland, Salsbury, Lone Star and Sea Island.

Unfortunately the piece of land on which these were grown is extremely poor and is hardly a fair test. A couple of the best plants of each variety were selfed for stock seed and they will be grown again in the coming season. The Acala seemed to be fairly promising and one plant was selected for the Progeny Rows.

### Small Bulk Increase Plots.

Four strains :—S.G. 27, S.G. 7, B. 1 and S.G. 23.8 were grown in small increase plots at Serere.

Table III.

| *Strain.* | *Area Grown. Acres.* | *Yield. lbs.* | *Yield per Acre. lbs.* |
|---|---|---|---|
| S.G. 27 ... ... ... | 1·08 | 500 | 465 |
| S.G. 23·8 ... ... ... | 0·64 | 533 | 830 |
| S.G. 7 ... ... ... ... | 0·47 | 350 | 745 |
| B. 1 ... ... ... ... | 0·39 | 250 | 640 |

The low yield of S.G. 27 as compared with that of the other three strains is due to the poor land on which it was grown, and also to the fact that many of the young plants were washed out by heavy rain, and that no re-sowing was done.

Table IV. (p. 203) shows the results of boll analysis made on each of the four strains. It must be noted, however, that the figures for S.G. 7 are compiled from sample bolls taken from a 5-acre plot grown at Toroma, Usuku.

Frequency tables were plotted for lint length, number of seed per 4-loc. boll, seed weight per boll and lint weight per boll, for each of the four strains. S.G. 23.8, S.G. 7 and B. 1 gave very good curves

TABLE IV.

BOLL ANALYSIS OF SMALL BULK INCREASE PLOTS.

| *Strain.* | *Where Grown.* | *Lint Length. Mm.* | *Loc. No.* | *Seeds per Boll.* | | **Motes per Boll.* | | *Seed Weight/Boll. Gms.* | | *Lint Weight/Boll. Gms.* | | *Ginning Percentage.* | | *Lint Index. (Calculated.)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4-*Loc.* | 5-*Loc.* | 4-*Loc.* | 5-*Loc.* | 4-*Loc.* | 5-*Loc.* | 4-*Loc.* | 5-*Loc.* | 12″ *Gm.* | *Calculated.* | |
| S.G. 27 ... | Serere | 31·94 ± 0·23<br>S.D. 2.19 | 4·02 | 33·45 ± 0·26<br>S.D. 2.36 | —<br>— | 1·57 | — | 3.55 ± 0·04<br>S.D. 0.40 | —<br>— | 1·69 ± 0·02<br>S.D. 0.21 | —<br>— | — | 32·3 | 5·05 |
| S.G. 23.8 | Serere | 29·16 ± 0·11<br>S.D. 1.90 | 4·21 | 32·22 ± 0·18<br>S.D. 2.78 | 39·28 ± 0·47<br>S.D. 3.73 | 2·14 | 3·48 | 3·08 ± 0·04<br>S.D. 0.54 | 3·87 ± 0·07<br>S.D. 0.52 | 1·81 ± 0·02<br>S.D. 0.28 | 2·08 ± 0·01<br>S.D. 0.11 | 35·0 | 37·0 | 5·62 |
| S.G. 7 ... | Toroma | 27·45 ± 0·20<br>S.D. 1.98 | 4·39 | 32·10 ± 0·35<br>S.D. 2.70 | 39·58 ± 0·53<br>S.D. 3.35 | 2·20 | 2·58 | 2·62 ± 0·07<br>S.D. 0.51 | 3·27 ± 0·08<br>S.D. 0.48 | 1·50 ± 0·03<br>S.D. 0.24 | 1·78 ± 0·04<br>S.D. 0.26 | 35·4 | 36·5 | 4·67 |
| B. 1 ... | Serere | 32·86 ± 0·16<br>S.D. 1.58 | 3·98 | 30·51 ± 0·28<br>S.D. 2.69 | — | 1·66 | — | 3.85 ± 0·04<br>S.D. 0.40 | — | 1·78 ± 0·03<br>S.D. 0.23 | — | 32·5 | 31·6 | 5·83 |

The Standard Error of the means is shown following the ± signs.
* Mote = undeveloped or aborted ovule.

for lint length while S.G. 27 is rather irregular. Bi-modal curves are formed by S.G. 23.8 and B.1 for the number of seeds per 4-loc. boll. S.G. 7 is very irregular in this respect, while the curve for S.G. 27 follows very closely the curve of lint length for this strain. S.G. 23.8 would appear to have a bi-modal curve for seed weight per boll, S.G. 27 being the most regular in this respect.

B. 1, S.G. 23.8 and S.G. 7 gave fairly regular curves for lint weight per boll, but S.G. 7 gave a very irregular curve which would appear to be very clearly bi-modal both for 4-loc. and 5-loc. bolls.

It must be noted that a certain number of seeds with pale green fuzz appear in the S.G. 27, also a few naked seeds.

The conclusion therefore is that none of the four strains is really pure. This is not surprising when one realises that B. 1, S.G. 7 and S.G. 27 have only been selfed for one generation. S.G. 23.8 has been selfed for two generations and is clearly a mixture of two strains which could be separated out by selection. The value of the latter proceeding is doubtful, however, as it gives a very good curve for lint length, and judging by the Brokers' Reports, (see later), is not a very desirable type of cotton.

There is every hope of selecting a very good strain from the S.G. 27, and this work is well on the way.

### Medium Bulk Increase Plots.

There was only one Medium Bulk Increase Plot in the 1928–29 Season, *i.e.*, S.G. 7 grown in a five-acre plot at Toroma, Usuku. Unfortunately the seed from this plot has been lost owing to the local chief selling the cotton without orders.

### The Main Bulk Increase.

S.G. 29 was chosen for the Main Bulk Increase crop for 1928–29 Season.

34 acres were grown at Serere and another 24 acres at the Simsa Plantation. The Serere crop gave 15,600 lbs. of seed cotton which gives an average of 460 lbs. per acre. The Simsa crop gave 8,200 lbs. of seed cotton, an average of 340 lbs. per acre. S.G. 29 was selected as a single plant from Nyasaland No. 13 in 1924. It was grown as a Progeny Row in 1925–26 and selfed. The seed from this row was run up through a small bulk increase and a medium bulk increase plot and then planted at Serere and Simsa as the main crop.

Table V. gives a summary of boll analysis of both Serere and Simsa crops.

TABLE V

SUMMARY OF S.G. 29.

| | *Lint Length. Mm.* | *Loc. No.* | *Seeds per Boll. 4-Loc. only.* | *Motes 4-Loc.* | *Seed Weight per Boll, 4-Loc. only. Gms.* | *Lint Weight per Boll, 4-Loc. only. Gms.* | *Lint Index. Gms.* | *G.O.T. %. Calculated.* |
|---|---|---|---|---|---|---|---|---|
| S.G. 29 ... Serere ... | $31{\cdot}51 \pm 0{\cdot}17$ $\sigma = 2{\cdot}34$ | 4·09 | $32{\cdot}29 \pm 0{\cdot}18$ $\sigma = 2{\cdot}56$ | 1·88 | $3{\cdot}49 \pm 0{\cdot}04$ $\sigma = 0{\cdot}52$ | $1{\cdot}85 \pm 0{\cdot}02$ $\sigma = 0{\cdot}32$ | 5·73 | 34·6 |
| S.G. 29 ... Simsa ... | $29{\cdot}56 \pm 0{\cdot}18$ $\sigma = 1{\cdot}79$ | 4·02 | $29{\cdot}95 \pm 0{\cdot}33$ $\sigma = 3{\cdot}02$ | 1·62 | $2{\cdot}68 \pm 0{\cdot}02$ $\sigma = 0{\cdot}46$ | $1{\cdot}54 \pm 0{\cdot}53$ $\sigma = 0{\cdot}29$ | 5·14 | 36·5 |

It will be seen that the strain lost nearly 2 mm. in lint length when grown at Simsa ; this difference being significant.

Diagrams 2, 3, 4 and 5 (pp. 206, 207), show the frequency distributions for lint length, number of seeds per boll, seed weight per boll and lint weight per boll respectively.

The lint length distribution might possible be bi-modal for the Serere crop, but that of Simsa is not. The latter would appear to have lost the whole of that part of the population which makes up the second mode. It is significant that the first mode of Serere coincides with the single mode of Simsa. The distribution of the number of seeds per boll shows similar tendencies to that of the lint length. The seed weight per boll is distributed very irregularly for both crops, with the Simsa mean markedly lower than that of Serere. The distribution for lint weight per boll is very regular in the case of Serere, but appears to be distinctly bi-modal for Simsa. From these results it seems possible that there may be two strains incorporated in S.G. 29 which react differently to different environments. When the combined crops were ginned it was found that there was a small proportion of seeds with green fuzz, the green being more marked than in the case of S.G. 27. A few naked seeds were found in a sample from the S.G. 29 plots of a variety trial at Bukalasa ; these may be due to volunteer plants of N. 17. The ginning of both Serere and Simsa crops was carried out at the Kyere ginnery of The East African Ginneries, Ltd. The whole ginnery was thoroughly cleared out under the personal supervision of the writer in order that no mixing of seed should take place.

The lint was sent to Liverpool in specially marked bales, while the seed was bagged and taken to Serere.

It is obvious that S.G. 29 is not a pure strain, but it is an advance on N. 17 in regularity, and it is to be distributed in the Eastern Province.

DIAGRAM. 2.

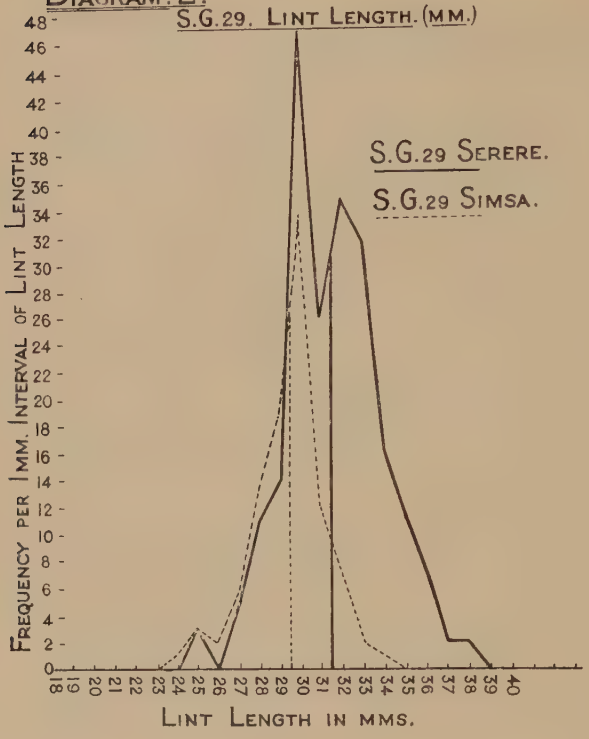



DIAGRAM 3

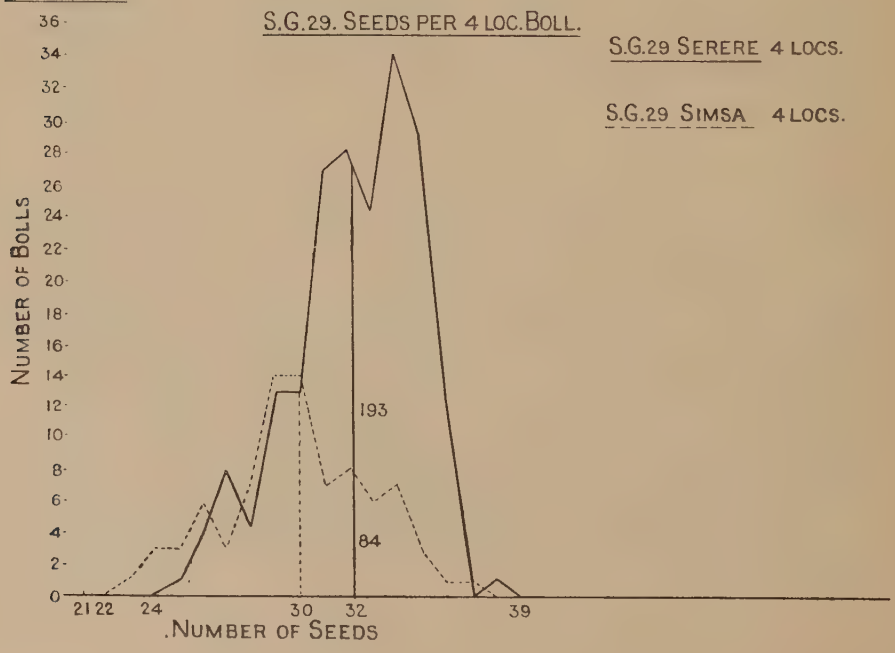


DIAGRAM. 4. S.G.29 SEED WEIGHT PER BOLL. (GMS.)

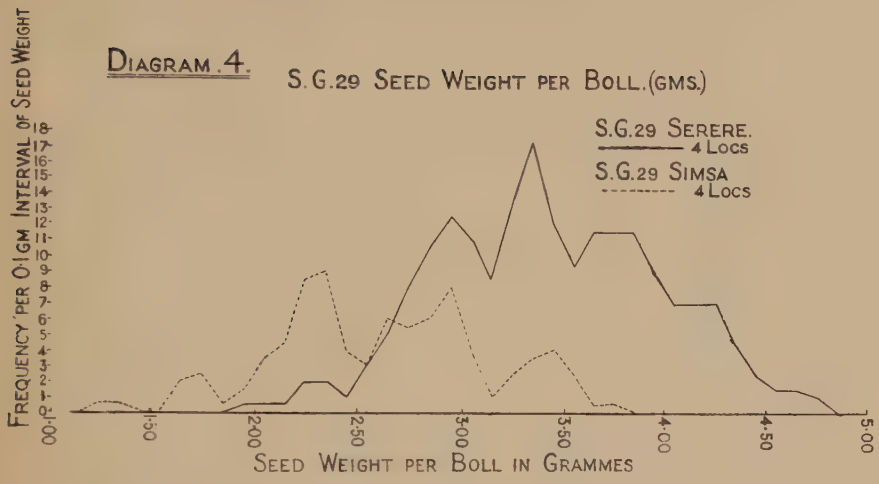
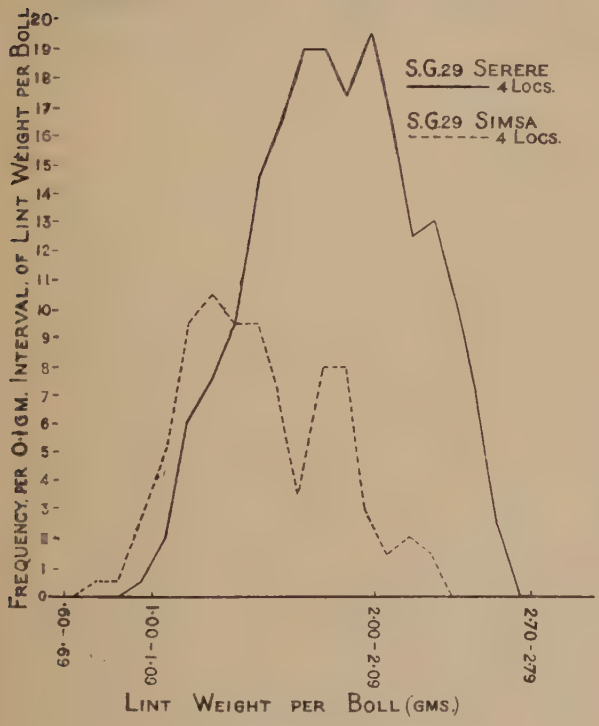



DIAGRAM. 5. LINT WEIGHT PER BOLL (GMS.)



The following is a summary of the mean yields of 5 plots each of S.G. 29 and N. 17 grown at eleven centres during 1928–29 season.

TABLE VI.

| Centre. | | N. 17. lbs. per $\frac{1}{20}$ acre. | S.G. 29. lbs. per $\frac{1}{20}$ acre. |
|---|---|---|---|
| TESO ... | Labori ... ... ... ... ... ... | 29·4 | 31·0 |
| | Serere ... ... ... ... ... ... | 19·0 | 18·7 |
| | Tira ... ... ... ... ... ... | 14·4 | 12·8 |
| | Soroti ... ... ... ... ... ... | 17·2 | 18·8 |
| | Katini ... ... ... ... ... ... | 16·2 | 14·2 |
| | Katakwi ... ... ... ... ... ... | 9·6 | 9·0 |
| LANGO... | Ngetta ... ... ... ... ... ... | 26·8 | 24·4 |
| | Kaberamaido ... ... ... ... ... | 29·8 | 29·6 |
| BUGWERE | Kamuge ... ... ... ... ... ... | 19·9 | 22·0 |
| BUGANDA | Kampala... ... ... ... ... ... | 10·5* | 11·3 |
| | Bukalasa... ... ... ... ... ... | 17·1* | 18·3 |
| | Means ... ... ... ... ... | 19·1 | 19·1 |

*** Local strain—N. 17 is not in general distribution in Buganda.**

S.G. 29 is quoted at a slightly higher price and with rather longer and more regular staple in the 1928–29 Brokers' Report (see later).

### THE MILONDO SCHEME.

The scheme for the multiplication of improved strains for general distribution—instigated by Mr. G. F. Clay (Senior Agricultural Officer)—which is being put into operation for the first time during the coming season is as follows :—

A. 1. Single plant selection.
2. Progeny Row, Serere.
3. Small Increase Plot, 1/4th acre, Serere.
4. Medium Increase Plot, 2 acres, Serere.
5. Seed Farm, 30 acres, Serere.

B. Segregated area of an administrative unit (meruka) of about 300 taxpayers, giving roughly 500–600 acres. This unit is situated on the Milondo Peninsular, which runs out into Lake Kioga, and is 24 miles from Serere.

C. The Eastern Province is divided up into 8 units of equal cotton acreage, each unit is at present about 50,000 acres, but allowance is made for expansion up to 100,000 acres per unit. In one of these 8 units an area producing 7,000–8,000 acres of cotton is to be selected annually, and the seed from "B" will be introduced into that area in one year and then spread over the whole unit in the second year.

By this scheme a fresh introduction of seed—either pure seed of the existing strain or seed of an improved strain—will be introduced

into each of the 8 units once every 8 years in rotation. The seed is under the direct control of the Cotton Botanist until it leaves the Milondo segregated area, after which the Field Staff are responsible for it.

Two strips 1,000 yards apart have been cleared across the neck of the peninsular. Euphorbia has been planted along each of these strips so that they are now permanent boundaries. Inside this thousand-yard wide area no cotton of any sort is to be grown.

In the 1929–30 Season S.G. 29 seed is being grown in the segregated area—*i.e.*, the seed from Serere and Simsa. As an additional precaution S.G. 29 seed is being distributed to the natives who live along the outer of the two boundaries. A buying store is to be erected inside the segregated area, and every precaution is to be taken during the buying season to prevent seed from going out or coming into the area. Native inspectors are resident in the area and have made a list of all the cultivators to whom S.G. 29 seed has been distributed. Previous to the commencement of the planting season these inspectors personally supervised the burning of all old plants and seed in the segregated area and in the forbidden zone between the two boundaries. They have also to see that no cotton is grown in the forbidden zone.

In this way it is to be hoped that the seed will be kept reasonably pure until it leaves Milondo for general multiplication and distribution.

### The Sowing-Date and Spacing Trial—Serere.

This is the third successive year that a combined sowing-date and spacing experiment has been carried out at Serere. The results this season were disappointing, considering the time expended upon it, but it has shown that the early-sown plantings are superior to the very late plantings.

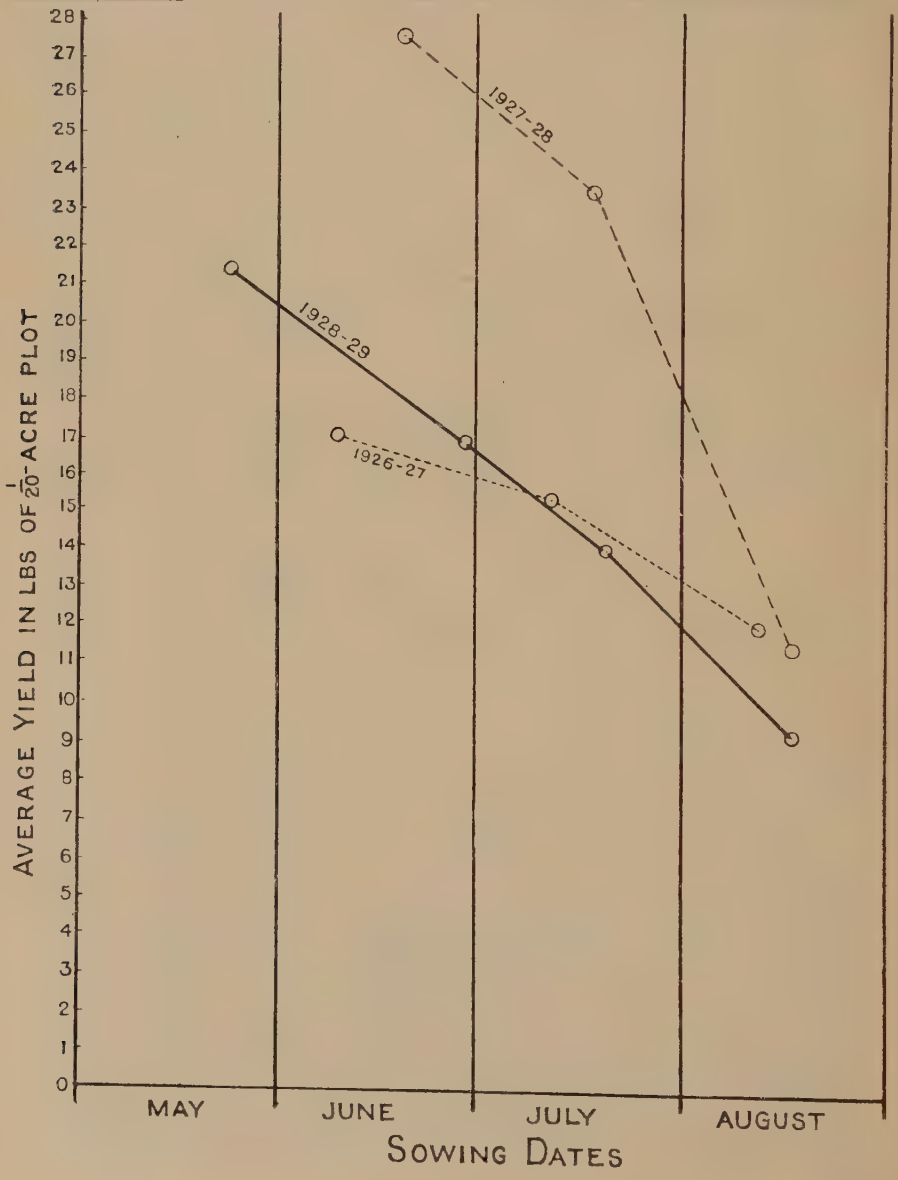
The native practice in Teso is to begin planting towards the end of May and to continue until about the middle or end of August, while the greater part of the crop is usually sown during the month of July.

It can be seen from Diagram 6 (p. 210) that from the experience at Serere for the last three seasons a considerable increase in the average yield—of Serere County at any rate—could be expected if the bulk of the planting were done in May-June. There are serious practical difficulties, however, which tend to keep down the amount of early-sown cotton. If the rains are late, then the food crops are late, consequently the native cultivator can only spare a small proportion of his time and land for cotton. The suggestion has been put forward by Mr. Clay that it may be possible to select, and distribute the seed of early maturing varieties of the food crops ; this would permit earlier planting

of cotton in years with normal rains. The abnormal year, *i.e.*, one with very late rains preceded by a prolonged dry season, would appear to be an insuperable difficulty if the average yield per acre is to be the maximum possible.

SOWING DATE EXPERIMENT.

DIAGRAM 6 YIELD CURVES FOR THE LAST THREE SEASONS.



In the trial at Serere this year the following sowing dates were tried :—

1. May 23. 2. June 29. 3. July 5. 4. August 16.

These four sowing dates were combined with 7 different spacings, making 28 treatments. The spacings were :—

(*a*) 4′ × 2′
(*b*) 3′ × 2′
(*c*) 5′ × 2′ (2 plants per hole).
(*d*) 4′ × 2′ (2 plants per hole).
(*e*) 3′ × 1′
(*f*) 3′ × 2′ (2 plants per hole).
(*g*) 3′ × 6″

In addition to the 28 treatments mentioned above there were two more treatments included in the June sowing date, *i.e.*, 4′ × 2′ sown on ridges and 4′ × 2′ intersown with beans. Very few of the beans germinated, so there were in effect two sets of 4′ × 2′ in the June sowing date.

Owing to a mistake at sowing there were no 3′ × 2′ or 3′ × 2′ (2 plants per hole) plots in the May sowing date, instead there was another set of 3′ × 1′ plots and also a set of 3′ × 1′ plots (2 plants per hole). Thus there were in all thirty treatments, each treatment being replicated five times. The plots were 30′ wide by 70′ long, and the outside rows were broken down before picking commenced. This latter proceeding is necessary, but when the rows have been broken the actual area of the harvested plot varies for different spacings. In the coming season this difficulty is being avoided by using plots which are compensated and are all of equal area after the outside rows are broken.

Table VII. shows the actual area harvested for the plots of the different spacings, and Table VIII. the actual area per plant (calculated from the stand) compares with that of the ideal 100% stand.

TABLE VII.

PLOT DIMENSIONS, ETC.

| *Spacing.* | *No. of Rows Harvested.* | *No. of Plants per Row Harvested.* | *Total Plants Harvested (100 % Stand).* | *Area of Plot at Harvest. Sq. feet.* | *Area Per Plant at Harvest. (100 % Stand). Sq. feet.* |
|---|---|---|---|---|---|
| 4′×2′ ... ... ... | 6 | 33 | 198 | 1,584 | 8·0 |
| 3′×2′ ... ... ... | 8 | 33 | 264 | 1,584 | 6·0 |
| 5′×2′—2 per hole ... | 5 | 66 | 330 | 1,650 | 5·0 |
| 4′×2′—2 per hole ... | 6 | 66 | 396 | 1,584 | 4·0 |
| 3′×1′ ... ... ... | 8 | 67 | 536 | 1,608 | 3·0 |
| 3′×2′—2 per hole ... | 8 | 66 | 528 | 1,584 | 3·0 |
| 3′×6″ ... ... ... | 8 | 138 | 1,104 | 1,656 | 1·5 |
| 3′×1′—2 per hole* ... | 8 | 134 | 1,072 | 1,608 | 1·5 |

* May plots only owing to error.

TABLE VIII.

ACTUAL AREA PER PLANT CALCULATED FROM MEAN STAND OBTAINED (in sq. feet.)

| *Spacing* | 4′×2′ | 3′×2′ | 5′×2′ 2 *per hole.* | 4′×2′ 2 *per hole.* | 3′×1′ | 3′×2′ 2 *per hole.* | 3′×6″ | 3′×1′ 2 *per hole.* | 4′×2′ *Ridged.* | 4′×2′ *Beans inter-sown.* |
|---|---|---|---|---|---|---|---|---|---|---|
| Ideal Area 1 Plant. | 8·0 | 6·0 | 5·0 | 4·0 | 3·0 | 3·0 | 1·5 | 1·5 | 8·0 | 8·0 |
| | | | | | 3·41 | | | | | |
| May Sowing | 8·34 | — | 5·97 | 4·31 | 3·51 | — | 1·80 | 1·73 | — | — |
| June ,, | 8·37 | 6·39 | 5·68 | 4·43 | 3·68 | 3·32 | 1·83 | — | 8·82 | 8·33 |
| July ,, | 8·86 | 6·72 | 5·60 | 4·64 | 3·78 | 3·43 | 2·02 | — | — | — |
| August ,, | 9·34 | 6·87 | 6·67 | 4·78 | 4·16 | 3·48 | 2·13 | — | — | — |

TABLE IX.

YIELD IN LBS. OF THE THIRTY TREATMENTS. (Means of 5 Plots.)

| *Sowing Date.* | *Average Yield of Sowing Date. lbs.* | *Average Total Yield of Spacings in lbs.* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4′×2′ | 3′×2′ | 5′×2′ 2 *Plants per Hole.* | 4′×2′ 2 *Plants per Hole.* | 3′×1′ | 3′×2′ 2 *Plants per Hole.* | 3′×6″ | 3′×1′ 2 *Plants per Hole.* | 4′×2′ *Ridged.* |
| | | | | | | {20·6 | | | | |
| May Sowing | 21·3 | 23·6 | — | 19·7 | 23·6 | {22·0 | — | 19·4 | 20·3 | — |
| June ,, | 16·9 | {18·1 16·6 | 17·8 | 15·6 | 17·3 | 16·5 | 15·3 | 17·4 | — | 17·1 |
| July ,, | 14·1 | 14·4 | 14·6 | 12·6 | 13·3 | 14·4 | 15·1 | 14·1 | — | — |
| August ,, | 9·2 | 8·6 | 9·9 | 7·2 | 8·8 | 10·6 | 9·1 | 9·9 | — | — |

TABLE X.

PERCENTAGE OF 2ND QUALITY COTTON ("FIFI") OF THE 30 TREATMENTS.

| *Sowing Date.* | *Average Percentage of "Fifi" of Sowing Dates.* | *Average Percentage of "Fifi" of Spacings.* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4′×2′ | 3′×2′ | 5′×2′ 2 *Plants per Hole.* | 4′×2′ 2 *Plants per Hole.* | 3′×1′ | 3′×2′ 2 *Plants per Hole.* | 3′×6″ | 3′×1′ 2 *Plants per Hole.* | 4′×2′ *Ridged.* |
| | | | | | | {45·8 | | | | |
| May Sowing | 47·1 | 41·4 | — | 47·6 | 49·0 | {47·6 | — | 51·4 | 46·8 | — |
| June ,, | 47·8 | {45·6 43·6 | 46·8 | 47·0 | 47·2 | 50·6 | 49·2 | 55·4 | — | 45·2 |
| July ,, | 53·4 | 51·4 | 49·2 | 51·6 | 52·0 | 55·2 | 55·4 | 58·8 | — | — |
| August ,, | 55·5 | 50·4 | 53·6 | 55·4 | 54·6 | 56·0 | 56·4 | 61·8 | — | — |

Table IX shows the average yield in lbs. (average of 5 plots in each case) of the different spacings in the four sowing dates

It will be seen that the average yield of the sowing dates—irrespective of spacing—is strictly in the order of sowing; the earliest sown have the highest yield.

The Standard Error of the Mean Difference of the 30 treatments is 1.60 lbs. The May plots as a whole are significantly better than the June. June is probably significant over July, while July is very significantly better than the August-sown plots. Inside each sowing date no significance was obtained between the different spacings, owing to the soil variation. As each picking was made, the cotton from each plot was sorted into " safi " (first quality) and " fifi " (second quality) and each part weighed separately. At the end the total yields of seed cotton (shown in Table IX.) were found from the " safi " and "fifi " of each plot. The mean percentage of fifi was then found for each of the 30 treatments, and these figures are shown in Table X. It can be seen that, on the whole, the closer the spacing the higher the percentage of "fifi." The figures for the mean percentage of " fifi " between the four sowing dates cannot be taken for comparison as the early sowings will obviously attract the stainers and thus bias the percentages of the later sowings.

The earliest planting with a $4' \times 2'$ spacing gives the highest yield of all the treatments. In the 1926–27 season the earliest planting with a close spacing of $3' \times 1'$ gave the highest yield, the $4' \times 2'$ being low in comparison. This happened again in 1927–28, and it is hard to find a reason for the $4' \times 2'$ spacing being the best this year. It is true that the experiment was carried out on one piece of land in 1926–27 and 1927–28 and was then moved to another part of the plantation for 1928–29, but there seems no obvious connection between the change of soil and the optimum spacing. Both 1927–28 and 1928–29 seasons experienced similar weather conditions.

It should be noted in passing that if a wide spacing gives the best yield for the earliest sowing, then a close spacing gives the best yield for the latest sowing (this was so in 1928–29). Conversely, if the close spacing is best for the earliest planting then the wide spacing is best for the latest planting (this was so in 1926–27 and 1927–28). Thus, there is in all probability a separate optimum spacing for each sowing date.

Referring to Diagram 1 (p. 199), it can be seen that the May and June plantings follow the high rainfall of March and April, consequently in these months the soil temperatures and evaporation rate are dropping rapidly and reach a minimum in May and June, whereas the June and July plantings coincide with a rise in the evaporation rate and soil temperatures.

In the season under review the plants ceased to yield by the end of February, thus the August-sown plants had nearly four months less time than the May plots for the production of a crop. This is in all probability the chief factor determining the difference in yield between the two plantings.

The importance of the sowing date is emphasized when one turns to the yields of the different varieties grown in the variety trial (see later). The difference in yield between May- and August-sown crops of the same variety is greater than the difference shown between any of the varieties grown.

### The Variety Trial at Serere.

This was carried out close to the Sowing Date and Spacing Trial. Six varieties were tried, with five replications of each variety.

Unfortunately the results of the Spinning Tests did not arrive in time, otherwise S.G. 27 would have replaced one of the other varieties actually included.

Quite early in the season it was possible to pick out the plots of S.G. 15 owing to the susceptibility of this strain to jassid attack, and as the season advanced the red discolouration of the leaves became more and more distinct.

N. 17 was the standard of comparison, since the seed of this strain is in general distribution throughout the Eastern Province. N. 19 is a similar strain of Nyasaland Upland. S.G. 15, S.G. 26 and S.G. 29 are all selections from the original Nyasaland Upland. S.G. 7 is a selection from a Salsbury variety imported from the U.S.A.; it has shorter staple and is much harsher than the other strains. It was thought that this variety might be suitable for the poorer soils and drier climate of Usuku, but in the trial in question, on poor land and in a very dry season, it compared very badly with N. 17.

The Standard Error of the Mean Difference is approximately 0.70 lbs.

Table XI. shows the mean yields (in lbs.) of the six varieties, the value of t (difference divided by S.E.) and the value of P obtained from Fisher's table of "t" (the table is entered at 4 degrees of freedom since there are five replications of each variety).

Table XI.

Variety Trial, Serere, 1928–29.

| *Variety.* | *Mean Yield lbs. per $\frac{1}{20}$ acre.* | *Difference.* | *t* | *Significance.* |
|---|---|---|---|---|
| N. 17 ... ... ... | 19·0 | — | — | — |
| S.G. 29 ... ... ... | 18·7 | 0·3 | 0·04 | P=1·0 approx. |
| N. 19 ... ... ... | 18·2 | 0·5 | 0·07 | P=1·0 approx. |
| S.G. 26 ... ... ... | 16·3 | 1·9 | 2·71 | P is greater than 0·05 |
| S.G. 7 ... ... ... | 14·9 | 1·4 | 2·00 | P is greater than 0·10 |
| S.G. 15 ... ... ... | 13·1 | 1·8 | 2·58 | P is greater than 0·05 |
| S.G. 29 ... ... ... | 18·7 | — | — | — |
| S.G. 26 ... ... ... | 16·3 | 2·4 | 3·43 | P is less than 0·05 |
| N. 19 ... ... ... | 18·2 | — | — | — |
| S.G. 7 ... ... ... | 14·9 | 3·3 | 4·61 | P is less than 0·01 |
| S.G. 26 ... ... ... | 16·3 | — | — | — |
| S.G. 15 ... ... ... | 13·1 | 3·2 | 4·57 | P is less than 0·02 |

The limit of significance is P = 0.05, consequently the results are as follows :—

1. No significance between N. 17, S.G. 29 and N. 19.
2. N. 17 and S.G. 29 are significantly better than S.G. 26, S.G. 7, and S.G. 15.
3. No significance between N. 19 and S.G. 26.
4. N. 19 is significantly better than S.G. 7 and S.G. 15.
5. No significance between S.G. 26 and S.G. 7.
6. S.G. 26 is significantly better than S.G. 15.
7. No significance between S.G. 7 and S.G. 15.

Table XII. shows the average percentage of "fifi" for the six varieties. The Standard Error of the Mean Difference is 2.0% of "fifi."

TABLE XII.

VARIETY TRIAL—PERCENTAGE OF "FIFI."

| *Variety.* | *Percentage of "Fifi."* | *Difference.* | *t* | *Significance.* |
|---|---|---|---|---|
| N. 19 ... ... ... | 34·6 | — | — | — |
| S.G. 15 ... ... ... | 36·2 | 1·6 | 0·80 | P is less than 0·40 |
| N. 17 ... ... ... | 37·6 | 1·4 | 0·70 | P is greater than 0·50 |
| S.G. 29 ... ... ... | 38·6 | 1·0 | 0·50 | P is less than 0·70 |
| S.G. 26 ... ... ... | 39·0 | 0·4 | 0·20 | P is less than 0·90 |
| S.G. 7 ... ... ... | 45·6 | 6·6 | 3·30 | P is less than 0·05 |
| N. 19 ... ... ... | 34·6 | — | — | — |
| S.G. 26 ... ... ... | 39·0 | 4·4 | 2·20 | P is greater than 0·05 |

*Conclusion.*—S.G. 7 has a significantly higher percentage of "fifi" than the other five varieties—there being no significance between the latter in this respect. It is difficult to see a reason for this. It may be that S.G. 7 is more susceptible to stainer attack or it may be more susceptible to the fungus introduced by the stainer or other plant bugs. Then, again, it is not certain that all the "fifi" is due to stainers only.

VARIETY TRIALS—OTHER THAN THOSE AT SERERE.

Variety trials were conducted at ten different centres—5 in Teso, 2 in Lango, 1 in Bugwere and 2 in Buganda. The results are summarised in Table XIII. There were five repetitions of each variety at each centre and the yields shown are the mean yields in lbs. of the 5 plots.

TABLE XIII.

MEAN YIELDS IN LBS. OF VARIETIES AT DIFFERENT CENTRES.

| *Centre.* | *N.* 17. | *S.G.* 29. | *S.G.* 26. | *S.G.* 7. | *S.G.* 15. | *Area of plot harvested (in sq. feet).* |
|---|---|---|---|---|---|---|
| Labori... ... | 29·4 | 31·0 | 24·4 | 31·2 | 23·2 | 10,500 |
| Tira ... ... | 14·4 | 12·8 | — | — | — | ,, |
| Soroti ... ... | 17·2 | 18·8 | 17·2 | 19·0 | — | ,, |
| Katiri ... ... | 16·2 | 14·2 | 13·0 | — | 10·0 | ,, |
| Katakwi ... | 9·6 | 9·0 | 9·0 | 9·2 | — | ,, |
| Ngetta... ... | 26·8 | 24·4 | 24·6 | — | 17·2 | ,, |
| Kaberamaido... | 29·6 | 29·8 | — | — | — | ,, |
| Kamuge ... | 19·9 | 22·0 | 21·0 | — | 16·5 | 10,800 |
| Kampala ... | 10·5* | 11·3 | 10·0 | — | 11·5 | 8,350 |
| Bukalasa ... | 17·1* | 18·3 | 15·0 | — | 13·1 | — |

* Local seed—not N. 17.

It will be seen that S.G. 15 was bottom in order of yield at every centre where it was represented—with the single exception of Kampala. S.G. 26 is beaten by N. 17—or by the local variety—in every case except that of Kamuge.

The following is a summary of the statistical analysis of the variety trials shown in Table XIII.

1. N. 17 and S.G. 29 show no significant differences.
2. S.G. 29 significantly beats S.G. 26 at two centres.
3. S.G. 15 is significantly beaten by :—S.G. 7 once, N. 19 once, N. 17 three times, S.G. 29 four times, S.G. 26 twice, and Local Buganda once.

## SOWING DATE AND SPACING TRIAL—BUKALASA.

This was conducted by the Agricultural Officer, Bukalasa, and the results are as follows :—

TABLE XIV.

MEAN YIELD IN LBS.

| *Spacings.* | *July 15th.* | *July 31st.* | *August 31st.* |
|---|---|---|---|
| 4′×2′ ... ... ... ... ... | 17·1 | 17·2 | 8·7 |
| 4′×1′ ... ... ... ... ... | 17·6 | 15·3 | 11·0 |
| 3′×2′ ... ... ... ... ... | 15·7 | 15·5 | 9·7 |
| 3′×1′ ... ... ... ... ... | 19·2 | 19·1 | 11·8 |
| Sowing Date Means ... ... ... | 17·4 | 16·8 | 10·3 |

In every case the July plantings were significantly better than August. No significant difference was obtained between the spacings within each sowing date. These results agree with the previous year's experiment. It will be noticed that the sowing dates are very much later in Buganda than in Teso.

### Spacing Trials other than Those at Serere.

Table XV. is a summary of six spacing trials conducted in the Eastern Province—three in Teso and three in Lango. The yields are in lbs. and are the means of 5 plots of each treatment.

Table XV.

Mean Yields in Lbs. per $\frac{1}{20}$ Acre.

| *Centre.* | 4′×2′ | 3′×2′ | 3′×1′ | 3′×2′ 2 *Plants per Hole.* | *Variety used.* | *Significance.* |
|---|---|---|---|---|---|---|
| Simsa ... | 13·4 | 16·8 | 15·0 | 16·4 | S.G. 29 | None. |
| Kyere ... | 25·8 | — | 29·3 | — | S.G. 29 | 3′×1′ signif. over 4′×2′ |
| Tira .. ... | 12·8 | — | 14·8 | — | S.G. 29 | None. |
| Ngetta ... | 25·7 | — | 27·4 | — | N. 17 | None. |
| Dokolo ... | 26·2 | — | 33·0 | — | N. 17 | 3′×1′ signif. over 4′×2′ |
| Kaberamaido | 31·6 | — | 34·8 | — | N. 17 | None. |

In every case 3′ × 1′ gave a higher yield than 4′ × 2′ spacing, but this difference was significant at only two centres out of the six.

### Brokers' and Spinners' Reports.

The spinning reports on the 1927–28 samples did not arrive in time for the planting of the Variety Trial in the 1928–29 season, otherwise S.G. 27 would have been included in the latter.

The following reports are quoted verbatim—

Table XVI.

1927-28 Broker's Report.

(Values based on Middling American @ 11·03d.)

| *Varieties in order of merit.* | *Value in Pence.* | *Staple* | *Strength.* | *Appearance.* | *Points on.* |
|---|---|---|---|---|---|
| S.G. 15 | 15.50 | Full 1 $\frac{3}{16}$″ | Strong | Silky and lustrous | 447 |
| S.G. 27 | 15.25 | Good 1 $\frac{3}{16}$″ | ,, | ,, ,, ,, | 422 |
| N. 17 ... | 15·00–15·25 | 1 $\frac{3}{16}$″ mixed with short and irregular | Medium to Strong | Fairly lustrous and fine. | 397–422 |
| N. 19 .. | 15·00–15·25 | Full 1$\frac{1}{8}$″ to 1$\frac{3}{16}$″ rather mixed with short. | Strong | Bright and lustrous | 397–422 |
| S.G. 29 | 15·00 | About 1$\frac{3}{16}$″ .. ... | ,, | Silky and lustrous | 397 |
| S.G. 26 | 14·50 | 1$\frac{1}{8}$″ to 1$\frac{3}{16}$″ irregular... | ,, | Fairly lustrous and fine. | 347 |
| S.G. 7 ... | 14·00 | Good 1$\frac{1}{8}$″ ... ... | ,, | Rather wanting in lustre and fineness. | 297 |

TABLE XVII

1927-28 RESULTS OF SPINNING TESTS.

| *Variety.* | *Nominal Count.* | *Amount of Twist Given (in Turns/inch).* | *Total Waste %.* | *Strength (Lea Tests in lbs.).* | *Work of Rupture in inch lbs./lea.* | *Actual Count.* |
|---|---|---|---|---|---|---|
| S.G. 15 ... ... ... | 46's twist | 27·75 | 4·8 | 45·6 | 60·3 | 46·4 |
| S.G. 27 ... ... ... | ,, ,, | ,, | 6·8 | 38·9 | 52·2 | 47·5 |
| N. 17 ... ... .. | ,, ,, | ,, | 6·0 | 43·9 | 56·5 | 46·4 |
| N. 19 ... ... ... | ,, ,, | ,, | 7·0 | 44·9 | 63·1 | 47·0 |
| S.G. 29 ... ... ... | ,, ,, | ,, | 6·6 | 40·4 | 53·6 | 47·6 |
| S.G. 26 ... ... ... | ,, ,, | ,, | 6·7 | 40·3 | 56·9 | 46·9 |
| S.G. 7 ... ... ... | ,, ,, | ,, | 4·6 | 34·1 | 49·7 | 47·9 |
| Arkansas S.M. Control ... | ,, ,, | ,, | 10·0 | 31·3 | 43·1 | 50·0 |

SUMMARY OF 1927-28 SPINNERS' REPORT :—

"1. *Yarn Examination :*

"Very decent yarns. S.G. 7 and Control (Arkansas S.M.) being particularly good.

"N. 19 gives a very regular thread, but not quite so clean as the first two.

"Order of merit in appearance :—

"S.G. 7, Control, N. 19, S.G. 26, S.G. 29, S.G. 27, S.G. 15 and N. 17.

"2. *General Report :*

"The behaviour throughout was very satisfactory. The samples were very clean and the carding was excellent, the waste loss being low.

"S.G. 27 was considered the best cotton and capable of spinning 60's twist or perhaps 84's weft.

"N. 19 was also commended.

"In fact all the samples, except S.G. 7, had probably been underspun and should certainly make decent yarns at, say, 64's weft.

"S.G. 7 seems quite a different type of cotton and should not go higher than 46's twist."

TABLE XVIII.

1928-29 BROKERS' REPORTS.

(Values based on Middling American @ 10·84d.)

| *Varieties in Order of Merit.* | *Value in Pence.* | *Staple.* | *Strength* | *Appearance.* | *Points On.* |
|---|---|---|---|---|---|
| S.G. 27 ... | 13·25 | $1\frac{3}{16}$" ... ... ... | Strong | Lustrous and fine | 241 |
| S.G. 29 ... | 12·25 | Full $1\frac{1}{8}$" to $1\frac{3}{16}$" ... | Medium | Fairly lustrous and fine. | 141 |
| S.G. 29.A.* S.G. 15 | 12·10 | Full $1\frac{1}{8}$" irregular ... | ,, | ,, ,, | 126 |
| N. 17 ... | 12·00 | Full $1\frac{1}{8}$" irregular ... | ,, | ,, ,, | 116 |
| S.G. 23·8 ... | 11·80 | Good $1\frac{1}{8}$" mixed with short. | Weak to Medium. | ,, ,, | 96 |

TABLE XVIII—*continued.*

| *Varieties in Order of Merit.* | *Value in Pence.* | *Staple.* | *Strength.* | *Appearance.* | *Points On.* |
|---|---|---|---|---|---|
| S.G. 7 ... | 11·70 | 1⅛″ much mixed with short. | Weak | Wanting lustre and fineness. | 86 |
| B. 1 ... ... | 11·60 | Average 1⅛″ ... ... | ,, | Fairly lustrous and fine. | 76 |
| N. 19 ... | 11·50 | 1⅛″, very much mixed with short. | ,, | ,, ,, | 66 |
| S.G. 26 ... | 10·75 | 1 1/16″ to 1⅛″ very wasty. | ,, | ,, ,, | 9 *off* |

* S.G. 29 grown on plots which have had cotton 4 years out of 5 with no manuring or cover crops.

The 1928–29 Spinners' Reports did not arrive in time for inclusion in the body of the report. They are, however, given in an Appendix (p. 221).

Comparing 1927–28 and 1928–29 Brokers' Reports it can be seen that :—

1. The premium has dropped considerably.
2. The staple has decreased on the whole.
3. Only one sample—S.G. 27—was quoted as strong in 1928–29, whereas all but one were strong in 1927–28.

There can be no doubt that the very dry season of 1928–29 is partly responsible for these changes.

The Brokers' Reports were made by Messrs. Wolstenholme and Holland, to whom our thanks are due.

The Spinning Tests were arranged by the Empire Cotton Growing Corporation through the Shirley Institute : to these two bodies and to the spinning firms that carried out the tests we are much indebted for the invaluable information embodied in these reports.

A report has also been received recently from the Liverpool Uganda Co. on the spinning of the main crop of S.G. 29 grown at Serere and Simsa. The results were very satisfactory, showing that this cotton was only slightly less valuable than Buganda cotton, and the spinner stated that this cotton was by far the best Eastern Province cotton that he has ever had in his Mill, and he considered it to be a very desirable style.

### PESTS AND DISEASES.

(*a*) Stainers put in an early appearance and were very numerous, causing a very high percentage of stained lint.

(*b*) The incidence of Spiny Boll Worm was normal, causing the usual amount of boll shedding.

(*c*) Jassids were noticeable on the Progeny Rows and were bad on the Variety Trial.

(*d*) At the end of the season many plots were stripped of leaves and flowers by a swarm of locusts. The latter gave cause for alarm, but appear to have been driven north.

(*e*) *Ramularia*, leaf mildew, appeared on the Progeny Rows early in the season. A certain amount of defoliation took place, but the disease passed off and the plants recovered.

(*f*) *Black Arm Disease* was widespread throughout Northern Teso. The virulence of the disease increased towards the North, and in parts of Usuku it was very serious, causing a total loss in some cases. According to the Mycologist's report, the disease broke out in Amuria County in September and spread gradually south, until Serere County was reached in November. The cool, moist weather during the rains gave ideal conditions for the spread of the infection and the multiplication of the organism. The only hope of control at present in Uganda is by the selection of resistant varieties. This is difficult owing to the variation shown from season to season in the amount of attack, and for this reason alone it would appear that, until more definite results are obtained from the research now in progress at Rothamstead and in the Sudan, little can be done. The ordinary routine work at Serere keeps the staff fully employed, and there are moreover no facilities for controlled inoculation experiments. For the latter it would be necessary, owing to the variation in climate, to have absolute control of the temperature and humidity, and this could only be done in greenhouses. Such experiments would have to be under the control of the Mycologist, who in turn would need every assistance from the Cotton Breeding Section and the Agricultural Officers in the districts.

### Conclusion.

1. The 1928–29 season showed a remarkably high percentage of " fifi " (second quality cotton).
2. The chief disease was Black Arm, which caused a varying amount of loss in Teso.
3. Stainers were very numerous and contributed largely to the high percentage of second quality cotton.
4. The chief feature of the 1928–29 season has been the evolution of the Milondo Seed Distribution Scheme for the Eastern Province, which is being put into practice in 1929–30 season. This marks a definite step forward since it is the first practical and up-to-date attempt at maintaining the purity of the seed distributed to the native growers.

5. The two main lines of attack, from the agricultural view point, upon the problem of improving the cotton industry of the Eastern Province are :—

   A. Increase of yield governed by such factors as :—
      (*a*) Correct sowing date.
      (*b*) Improvement and upkeep of the soil fertility by proper rotations.
      (*c*) Correct spacing.
      (*d*) Cultural methods in general, such as prevention of wash, seed rate, filling in of blanks, ploughing, etc.

   B. Increase of yield and improvement of quality—and hence value—effected by selection and by the proper control of improved seed up to the time of its general distribution.

   The problems under A are being undertaken by the General Division, and those of B by the Cotton Breeding Section.

6. It should be noted, in conclusion, that the experience gained at Serere applies only to that portion or portions of the Eastern Province having the same type of climate and similar soil.

## Addendum.

The results of the 1928–29 Spinning Reports came to hand just before this report was sent home ; they are as follows :—

1928–29. Results of Spinning Tests.

| *Variety.* | *Nominal count.* | *Amount of twist given (in turns/inch).* | *Total waste. %* | *Strength (Lea Tests in lbs.)* | *Work of rupture in inch lbs./lea.* | *Actual count.* |
|---|---|---|---|---|---|---|
| N 17 ... | 46's twist | 27·97 | 13·2 | 34·5 | 58·4 | 45·3 |
| N 19 ... | „ „ | „ | 13·8 | 29·1 | 47·1 | 47·7 |
| SG 15 ... | „ „ | „ | 12·5 | 34·9 | 52·4 | 46·8 |
| SG 27 ... | „ „ | „ | 10·0 | 33·3 | 61·8 | 45·4 |
| SG 29 ... | „ „ | „ | 10·5 | 34·4 | 58·1 | 46·2 |
| SG 29A ... | „ „ | „ | 11·8 | 29·2 | 43·7 | 49·6 |
| B 1 ... | „ „ | „ | 13·2 | 25·4 | 37·0 | 50·4 |
| Control ... | „ „ | „ | 10·3 | 28·0 | 46·8 | 48·2 |
| SG 7 ... | 40's twist | 21·93 | 12·5 | 22·8 | 48·1 | 41·0 |
| SG 26 ... | „ „ | „ | 18·2 | 13·5 | 35·5 | 43·6 |
| SG 23.8 ... | „ „ | „ | 10·3 | 54·0 | 68·1 | 37·7 |
| Control ... | „ „ | „ | 10·3 | 36·8 | 56·9 | 40·4 |
| SG 7 ... | 32's twist | 18·80 | 12·5 | 36·3 | 69·1 | 32·0 |
| SG 26 ... | „ „ | „ | 18·2 | 21·5 | 51·3 | 33·7 |
| SG 23.8 ... | „ „ | „ | 10·3 | 73·8 | 88·1 | 30·0 |
| Control ... | „ „ | „ | 10·3 | 52·5 | 76·7 | 31·1 |

The control was Arkansas S.M. $1\frac{1}{8}$″ to $1\frac{3}{16}$″, in each case.

GROUP I.

*Yarn Examination.* The yarns on the whole were considered not good. The majority were lumpy, uneven and dirty. The Control was easily the best in appearance and the complete order is as follows:—1, Control. 2, N. 17. 3, S.G. 27. 4, S.G. 29. 5, S.G. 29A. 6, S.G. 15. 7, N. 19. 8, B. 1.

The last three were judged particularly bad.

*General Report.* The waste losses in most of the samples were rather high. N. 17 gave leafy and seedy strips; S.G. 27 was easily the best with regard to carding.

In the speed frames S.G. 27, S.G. 29 and N. 17 gave promise of the best yarns, these samples requiring rather less twist and giving a more even roving than the others; N. 19 was very uneven.

In the spinning the samples were practically normal, but breakages were rather more frequent than with the Control and the yarns appeared more irregular.

The cottons are on the whole very irregular in staple, rather soft and of wasty nature. Many of them gave, however, surprisingly good strength in the yarn. Nevertheless, it was considered that the majority had been overspun and would probably have been more successful at about 32's or 36's.

GROUP 2.

*Yarn Examination.* S.G. 23.8 is easily the best of these yarns. It is nearly as good as the Control, but the other two (S.G. 7 and S.G. 26) are bad, particularly the latter.

*General Report.* S.G. 23.8 is not a bad cotton, though not the equal of the Control from the point of view of regularity; yet it gave an extraordinary strong yarn.

S.G. 7 is bad and S.G. 26 is very poor indeed. The latter gave trouble in all the processes; it carded badly, and the waste loss was very heavy, it required far more twist in the speed frames, and in the mule was practically unspinnable at 40's. Its performance in the mule at 32's was slightly better (see Group 3).

S.G. 23.8 might possibly have been spun with Group 1 at 46's: it is rather irregular, but much better than S.G. 7 or S.G. 26.

GROUP 3.

*Yarn Examination.* The order of merit is the same as for the 40's yarns spun from the same samples, *viz.*:—

1, Control. 2, S.G. 23.8. 3, S.G. 7. 4, S.G. 26.

*General Report.* S.G. 7 and S.G. 26 are still bad, but slightly better than in the 40's (see Group 2). These two samples are easily the worst of the whole batch, and are probably more suitable for

counts in the neighbourhood of 20's. The heavy waste loss of S.G. 26 is a bad feature which would militate against success even in coarse counts.

Taken on the whole the above Report is very disappointing, but one has to make allowances for the effect of the season on these strains. There is no doubt whatever that the conditions experienced in the 1928–29 season were extremely unfavourable.

As a result of this report the opinion expressed as to the value of re-selecting in the strain S.G. 23.8 will have to be revised. The irregularity of staple should be easy to eliminate, but there is always the danger that the re-selected strain will not be so promising as regards spinning qualities.

As a matter of interest the following table has been compiled. The product of the Actual Count and the Strength (Lea Tests in lbs.), according to Dr. Balls in his "Studies of Quality of Cotton," gives a rational quantity that represents "Yarn Strength." He says that this rational quantity should be the same for one cotton at all counts if other things are equal.

It is assumed that the correlation between the two factors, Actual Count and Strength, is perfect.

ACTUAL COUNT × STRENGTH. (AC. × S.).

| *Variety.* | 1926–27. | | 1927–28. | | 1928–29. | |
|---|---|---|---|---|---|---|
| | *AC.* × *S.* | *Nominal Count.* | *AC.* × *S.* | *Nominal Count.* | *AC.* × *S.* | *Nominal Count.* |
| N 17 ... ... | — | — | 2040 | 46's | 1560 | 46's |
| N 19 ... ... | — | — | 2120 | „ | 1390 | „ |
| SG 7 ... ... | — | — | 1640 | „ | 935<br>1160 | 40's<br>32's |
| SG 15 ... ... | 2040 | 58's | 2110 | „ | 1630 | 46's |
| SG 23.8 ... | — | — | — | — | 2040<br>2210 | 40's<br>32's |
| SG 26 ... ... | 1620 | 58's | 1890 | 46's | 590<br>730 | 40's<br>32's |
| SG 27 ... ... | 1700 | „ | 1850 | „ | 1510 | 46's |
| SG 29 ... ... | 1650 | „ | 1850 | „ | 1590<br>1450* | „<br>„ |
| B 1 ... ... | — | — | — | — | 1280 | „ |
| East Afric-Control ... | 1570 | 58's | — | — | — | — |
| Arkansas S.M. | — | — | 1570 | 46's | 1350<br>1490<br>1630 | 46's<br>40's<br>32's |

* Denotes SG 29 grown on land which has had cotton 4 years out of 5.

From the above it will be seen the Yarn Strengths of all the strains tested in the previous season are lower this year, a result for which the bad season was doubtless largely responsible.

## APPENDIX 1.

The data obtained from the five observation rows of ten plants each of S.G. 23.8 were further analysed in the following manner.

The average weight of a single seed and the average weight of lint per single seed were calculated for all the bolls weighed. Then the 4-loc. bolls were gathered into ten groups, each group consisting of bolls picked on the same day. As there were ten weekly picks this gave the ten groups; it was found, however, that picks 8, 9 and 10 gave less than ten 4-loc. bolls, so only the first seven groups were used for finding the averages.

The following averages were determined for each of the 7 picks :—

1. Average number of good seeds per boll.
2. Average number of motes per boll (*i.e.*, immature seeds).
3. Average weight in gms. of a single seed.
4. Average weight in gms. of the lint on a single seed.
5. Average lint length in millimetres.
6. The average ginning percentage calculated from 3 and 4.

It should be noted that all the above averages were determined from 4-loc. bolls, sound in all four loculi.

The six averages thus obtained were plotted against the date of picking. The accompanying diagrams (pp. 228, 229) bring out the following interesting facts :—

(i) The average number of good seeds per boll increases rapidly for the first three picks and then becomes more or less constant.

(ii) The average number of motes shows wide variation, but does not seem to follow any definite trend as in (i).

(iii) The average weight of a single seed drops steadily from the 1st to the 6th pick, and then rises slightly at the 7th.

(iv) The average weight of lint per seed drops steadily from the 1st to the 3rd picks, but shows a marked rise at the 4th pick (January 5th). From the 4th to the 7th pick it again shows a steady fall.

In Uganda the number of days from the opening of the flower to the ripe boll lies between 56 and 60. It is interesting to note that the flowers which gave rise to the 4th pick must have opened during a very rainy spell of ten consecutive days from November 7th to November 16th inclusive. (4.02 inches of rain fell during this period.) The result of this rain was to cause the lint per boll to rise very markedly, although the weight of a single seed shows no such rise.

(v) The lint length is a minimum at the first pick. The maximum is at the 4th pick and is probably due to the rainy ten days in November.

(vi) The ginning percentage shows a most remarkable variation. It drops rapidly from pick 1 to pick 3 and then goes up tremendously at pick 4. (This is to be expected when one looks at the seed weight and lint weight curves.) It remains more or less constant during the 4th, 5th and 6th picks and then falls away rapidly at the 7th. (The latter is due to the sudden rise in seed weight at the 7th pick.)

It is of interest to compare these curves with those on page 90 of " The Development of Raw Cotton," by Dr. Balls, and also with similar curves shown in " The Changes in the Properties of Raw Cotton Correlated with the Plant's Age," by G. S. Zaitzev and A. M. Gasteva.

By multiplying the average number of seeds per boll by the average weight of lint per seed one can obtain the average amount of lint per boll. The curve follows very closely that of the weight of lint per seed; this was to be expected from Harland's statement that " . . . of the morphological characters bearing on yield, weight of lint per seed was the most important, by virtue of the high positive correlation which it exhibits both with weight of lint per boll and weight of lint per acre." (" The Yielding Power of Pure Strains of Sea Island Cotton compared with that of Commercial Varieties," by S. C. Harland, *Empire Cotton Growing Review, Vol. II., No.* 2.)

AVERAGES FROM 7 WEEKLY PICKS—VARIETY S.G. 23.8.

| *No. of Pick.* | *Date.* | *Average No. of Seeds per Boll.* | *Average No. of Motes per Boll.* | *Average Weight of Single Seed. Gms.* | *Average Weight of Lint per Seed. Gms.* | *Lint Length Mms.* | *Ginning Per-centage.* | *Average Weight of Lint per Boll. Gms.* |
|---|---|---|---|---|---|---|---|---|
| 1 | Dec. 15 | 28·3 | 2·0 | 0·117 | 0·061 | 27·8 | 34·3 | 1·73 |
| 2 | „ 22 | 30·9 | 2·7 | 0·109 | 0·056 | 29·4 | 33·9 | 1·73 |
| 3 | „ 29 | 32·6 | 2·2 | 0·105 | 0·051 | 29·4 | 32·7 | 1·66 |
| 4 | Jan. 5 | 32·2 | 2·2 | 0·095 | 0·055 | 30·0 | 36·7 | 1·77 |
| 5 | „ 12 | 32·7 | 2·1 | 0·091 | 0·053 | 28·8 | 36·8 | 1·73 |
| 6 | „ 19 | 33·1 | 1·8 | 0·086 | 0·051 | 28·7 | 37·2 | 1·69 |
| 7 | „ 26 | 32·5 | 2·7 | 0·092 | 0·048 | 28·7 | 34·3 | 1·56 |

## APPENDIX 2.

### THE USUKU, NEPAK AND AMURIA COUNTIES OF TESO.

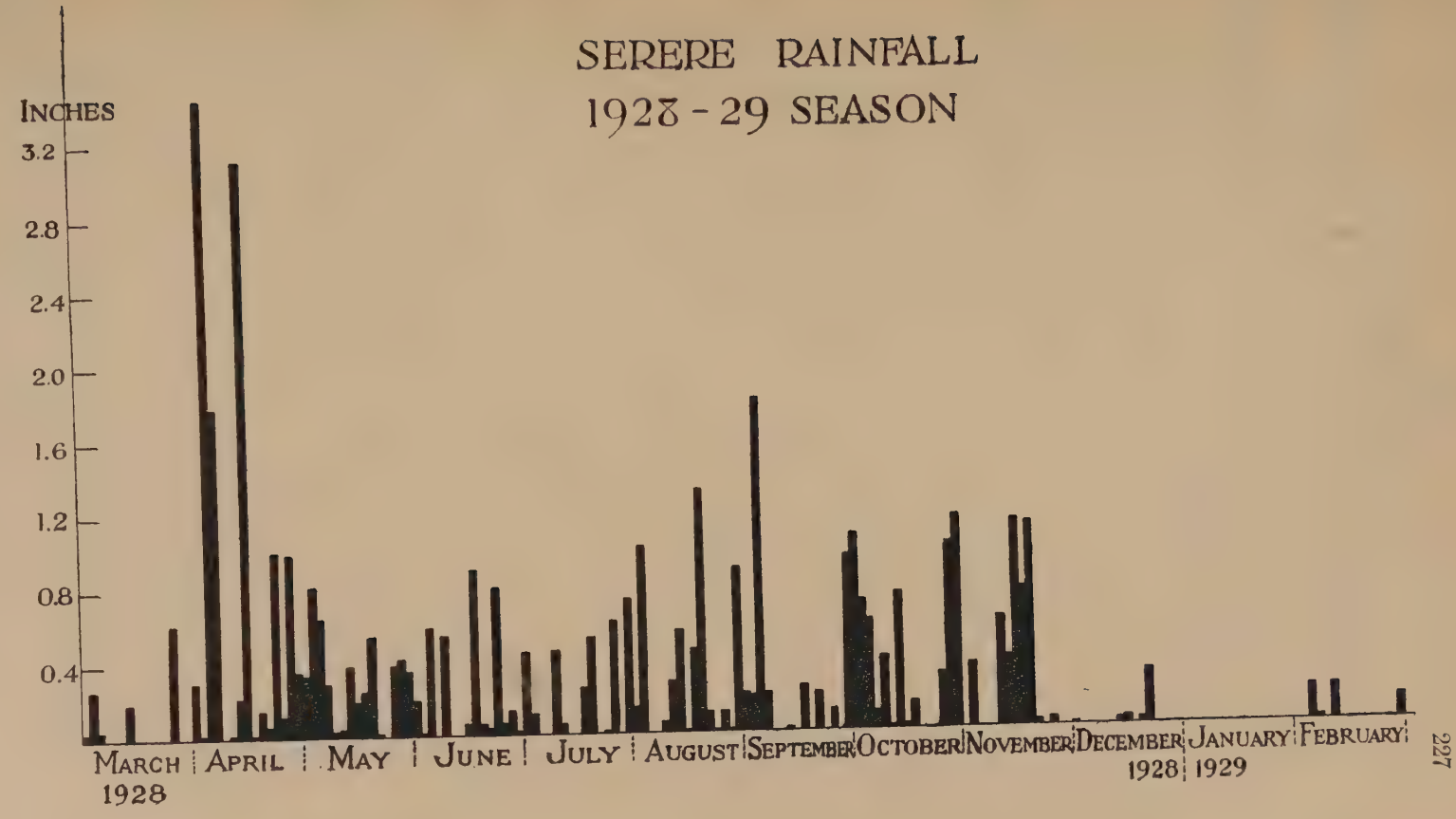
These three counties are at the southern edge of the arid and uninhabited areas of Karamoja. The average yield is extremely low —being less than 150 lbs. of seed cotton per acre—and in some places it is next to nothing. The soil is very light, with little colloidal matter,

and runs together after rain and forms a sandy surface. Ironstone and granite are very close to the surface in many places, at others the clay subsoil is so close to the top that waterlogging occurs after rain.

Cotton is grown yearly and with very discouraging results to the natives. These natives have been badly hit by famine and rinderpest, and the position is critical. Under these conditions, most of the outside experiments are being concentrated in these areas in the coming season.

Selections were made from a Salsbury strain (S.G. 7) grown for observation purposes in Usuku, and also from the same strain at Serere. These selections are being planted out as Progeny Rows at Katakwi, in Usuku, in the coming season. A native who has been trained at Serere is stationed at Katakwi to supervise the Progeny Rows and Variety Trial. He will make daily flowering and bolling records throughout the season. It is probably impossible to select a strain from Nyasaland Upland to give a very high yield in Usuku : the only hope is to try to improve the average yield as much as possible by selection and by improved cultural methods. The Senior Agricultural Officer is conducting spacing trials, at several centres in these districts, with this end in view. It is noticeable that in places where the soil is reasonably deep the ant-hills are more fertile than the surrounding land—this is exactly opposed to the conditions at Serere, where cotton only grows with difficulty on the ant-hills. In many places the plants would appear to be suffering from a lack of soil aeration. Large ridges would prevent this. At Adachal, in the coming season, a combined trial of ridges versus flat and N. 17 versus S.G. 7 is being tried.

An alternative method to prevent the soil surface from running together is being tried by the Senior Agricultural Officer ; this entails planting cotton between established rows of groundnuts (groundnuts are the most successful crop in Usuku). The groundnuts are planted in rows one foot apart ; the cotton is then planted about one month later in rows four feet apart, there being two rows of groundnuts between each cotton row. It is hoped that the cover afforded by the groundnuts will prevent the surface wash.


SERERE RAINFALL
1928 - 29 SEASON
INCHES
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
MARCH
1928
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
1928
JANUARY
1929
FEBRUARY
2917

## APPENDIX I.

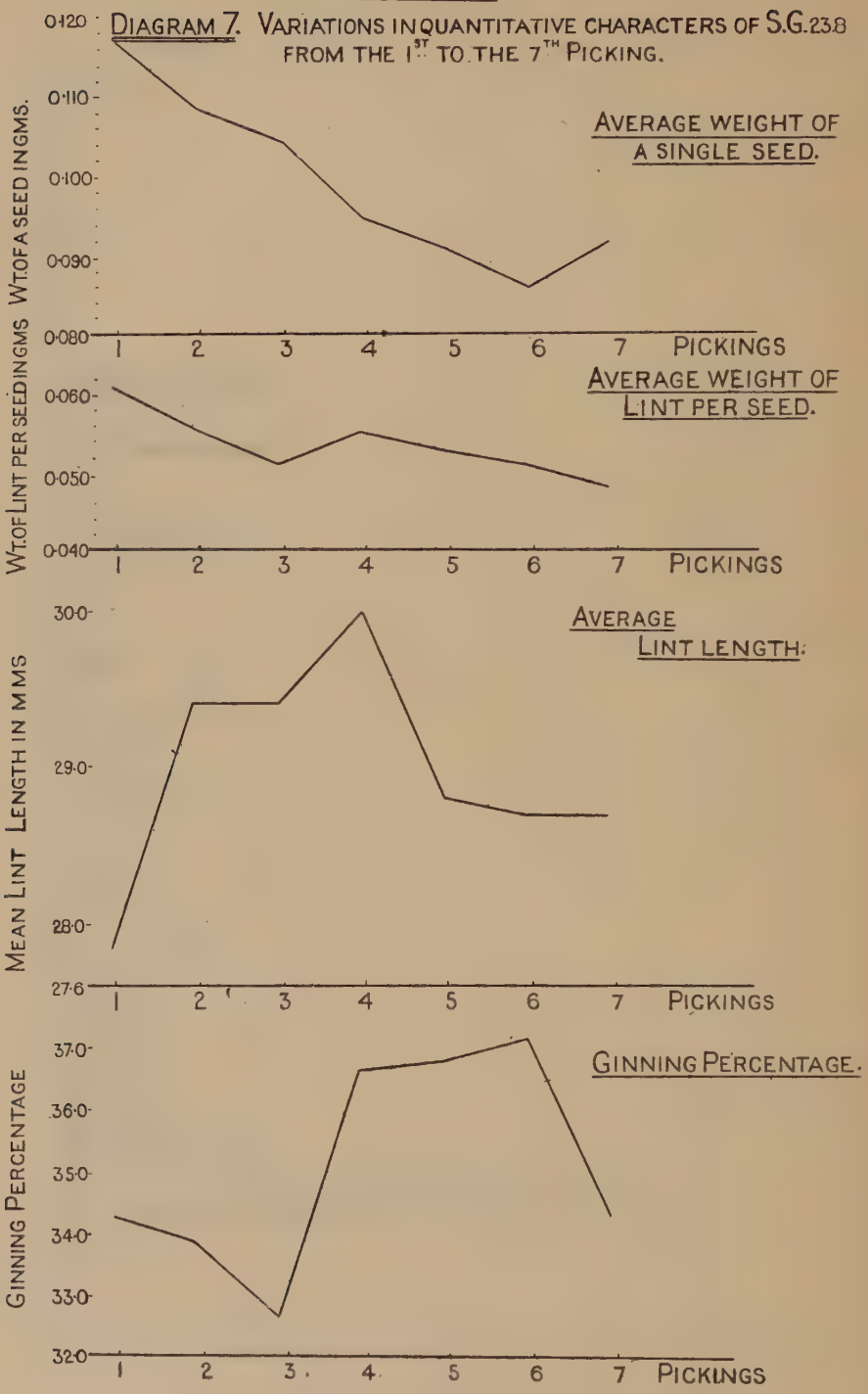
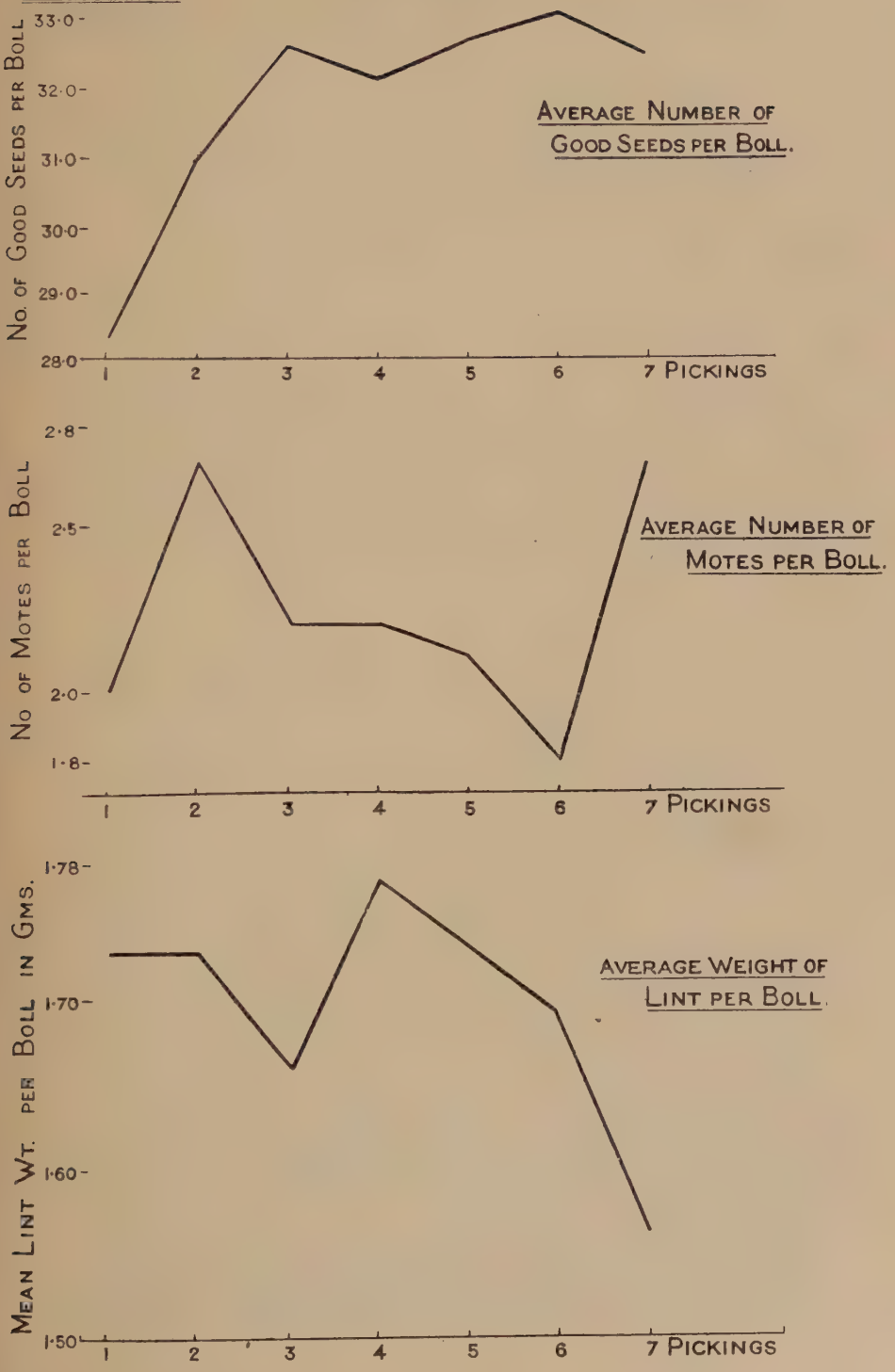


DIAGRAM 7. VARIATIONS IN QUANTITATIVE CHARACTERS OF S.G.238 FROM THE 1ST TO THE 7TH PICKING.
AVERAGE WEIGHT OF A SINGLE SEED.
WT OF A SEED IN GMS.
0·120
0·110
0·100
0·090
0·080
1 2 3 4 5 6 7 PICKINGS
AVERAGE WEIGHT OF LINT PER SEED.
WT OF LINT PER SEED IN GMS
0·060
0·050
0·040
1 2 3 4 5 6 7 PICKINGS
AVERAGE LINT LENGTH.
MEAN LINT LENGTH IN MMS
30·0
29·0
28·0
27·6
1 2 3 4 5 6 7 PICKINGS
GINNING PERCENTAGE.
GINNING PERCENTAGE
37·0
36·0
35·0
34·0
33·0
32·0
1 2 3 4 5 6 7 PICKINGS

## APPENDIX I.

DIAGRAM. 8.



# NYASALAND

## REPORT ON THE WORK OF THE COTTON EXPERIMENT STATIONS, SEASON 1928-29.

BY

H. C. DUCKER.

### Introduction.

*Staff During the Year.*—Mr Miller was in charge of the Makwapala Station until April, when he proceeded to Port Herald. Mr. Ducker proceeded on leave in November, returning in April. During his absence Mr. Lochrie was acting Cotton Specialist, and, in addition to the routine duties of the post, had charge of the Port Herald Station. On Mr. Lochrie's departure on leave in May Mr. Ducker assumed control of Makwapala, Mr. Miller remaining at Port Herald.

### Summary.

Though in part the report on the Makwapala Station is a record of failure, the season at this Station has not been without its brighter points, and it seems probable that the fresh ideas engendered by this partial failure may yield valuable results.

It has been increasingly obvious since 1925 that the weakest point about Makwapala is its soil; this is a residual loam, resting on metamorphic gneisses and schists, which under the climatic conditions of the area has become highly laterised. Under conditions of cultivation this laterised loam has developed an ironstone pan relatively impermeable to water, which under the Makwapala conditions gave rise to extensive erosion. As has already been reported, efforts have been made to check this erosion, by means of graded ridge terraces, with a fair measure of success, but the problem of the pan, formed before these measures were tried, remains.

The experience of this and past seasons at Makwapala is that, while early maturing shallow-rooted crops like maize and tobacco do well as long as there is no superficial water logging, cotton and other late maturing deep-rooted crops suffer severely immediately the rains cease and the surface soil dries out.

There is, however, one notable exception, Pigeon Pea (*Cajanus indicus*), known locally as Nandolo, which is undoubtedly capable of breaking up the pan and reaching the subsoil moisture. This crop

remains green throughout the dry season and makes its crop five months after the rains have ceased.

It would seem that this crop can do what the local flora, mainly *Brachystegia* spp. appear able to do, break up any pan formed and in some measure reverse the procedure of pan formation. An extensive trial is therefore being given to it in the rotation practice at Makwapala.

In addition, attempts are being made to increase the depth of the surface soil by cultivation. A modification in ploughing methods has resulted in an increase of four inches in the plough depth of previous years.

An extended programme of organic manuring has been adopted since there are indications that the pan formation is associated with the loss of humus by the soil.

The Over-the-Top variety of cotton, selected before the soil problems of the Station became acute, and helped by the exceedingly favourable season of 1926/27, has, in the past two seasons, shown increasing difficulty in coping with the conditions, and it is pleasing to note that U.4 obtained from Barberton has shown signs of being better able to do so. It seems very probable that Nyasaland will have as much reason to be grateful to Mr. Parnell as has S. Rhodesia, since this strain has in the past season shown itself as suitable for Port Herald as for Makwapala.

Though the writer is glad to be able to say that the future of cotton in Nyasaland does not entirely depend on the solution of the Makwapala problems, such solution will open possibilities for cotton over areas outside our present calculations.

As has been reported before, cottons taken from Makwapala and tried out elsewhere under better soil conditions have nearly always done better than on the Station, and it is of interest to note that a 10-acre plot of Over-the-Top B at Karonga has this season given the highest recorded yield for Nyasaland, 1,220 lbs. seed-cotton per acre, about 390 lbs. lint per acre, of which 374 lbs. was clean and white. This strain has displaced Nyasaland Upland almost entirely in areas other than the Lower Shire, and it will be of interest to see whether it in its turn will be displaced by U.4.

The Port Herald Station has had the best season, as far as results go, since its commencement, and a big step forward has been made towards a reasonably complete knowledge of Lower Shire problems. Enough already has been learnt to suggest the possibility of increasing the present crop by up to 50%, merely by getting all sowing done within a certain period of time, and energetic propaganda may see this done within the next season or so.

Two strains from S. Africa, U.4 from Barberton and Cambodia 664 from Gatooma, have overtopped all else, and the records made indicate that these two should be the Port Herald cottons for 1930. Confirmation of this season's results and a seed bulking scheme, at present under consideration, can be put in operation, and the present Lower Shire seed stock replaced by a better strain.

Further attempts have been made without success to extract an improved strain out of the ordinary Nyasaland Upland. Several hundred single-plant selections have now been grown on the Stations, but none has so far proved satisfactory. The conclusion has therefore been reached that this strain as it now exists is more or less incapable of improvement by straight selection and that it will be best to concentrate on the imported strains, especially U.4, which shows such promise. A possible explanation of our lack of success is that practically all Nyasaland Upland seed available is descended from a more or less pure line selected in the past by the Department of Agriculture, and that the difficulty of extracting off types of promise is augmented by the lack of definiteness of the jassid attack. The writer has only twice in Nyasaland seen anything approaching the definiteness of the attack by jassid seen by him at Barberton last year, and in neither case was this on Nyasaland Upland.

## Makwapala Experiment Station, Report for the Season 1928/29.

*Season.*—Early and promising rains were followed by a dry spell which lasted until the first week of January and to a considerable degree offset the advantages of the early start.

As in previous seasons, a wet, dull spell occurred in March which favoured the pests rather than the cottons, and was also a difficulty where the tobacco curing was concerned. It must be feared that this spell of cold wet weather is a normal event at Makwapala, and that, unless some modification in the methods of cultivation, or change in the variety overcomes its effects, it will be a source of trouble to cotton in most seasons. The only year in which this spell has not occurred since cotton-growing was commenced at Makwapala is 1926/27, when the record crop for the Station was grown.

Minimum temperatures dropped below 60° F. on May 10th as against May 5th last season.

*General.*—The work of the Station has continued on lines similar to those of the past three seasons.

Several more implements have been obtained for the cattle, all of which have done good work. Special mention must be made of light spring tine cultivators obtained from Ransomes, and of Ransomes R.H.R.L. ridger. Fuller realisation of the troubles due to the ironstone pan reported last season has directed attention to the need for improved cultivation. A modification in the ploughing methods made possible by the new implements has considerably increased the plough depth. The procedure consists in rough-ridging the land after the first ploughing, ploughing between the ridges, splitting them back with the ridger and ploughing again between them. The depth broken has thus been increased from about 5 to 9 inches without undue mixing of the soil and subsoil.

A stock of upwards of 50 tons of a farmyard manure compost has now been accumulated and an extended programme of organic manuring is under way. There is evidence that the hardening of the lateritic ironstone pan with which the station is afflicted is in part connected with loss of humus by the soil. A heavy application of organic manure to next season's maize crop should help to throw some light on this matter.

The ridge terraces have stood up well, but some minor difficulties arose due to local and temporary waterlogging above the terraces. This it is hoped has been got over by improvements to the grade of the terraces and by leaving a water furrow on their upper side. The method of breakwaters in the drains reported last season promises to be successful in controlling erosion. It is of value in allowing grass to become established in the drains.

During the season all farm buildings of importance other than the tobacco bulk shed have been re-roofed with corrugated iron. It has been decided to keep thatch on the bulk shed on account of its superior insulating power. Under an iron roof it is difficult to keep tobacco moist enough to handle. The labour lines have been completed and a hut larger than the rest built for the head capitao. The lines are popular with most of the labour, but a few conservatives prefer their grass huts.

Two wells were sunk during the season. One in the middle of the labour lines is providing sufficient drinking water for the whole labour force, and it is to be hoped that the provision of this purer supply will do away with the outbreak of sickness amongst the labour which usually coincides with the break of the rains. This sickness is undoubtedly due to the stream from which their drinking water was formerly obtained. The other well was sunk in the small eucalyptus plantation on the Station and water has been struck in quantity. This well

has been brick-lined and housed over and serves the Europeans on the Station.

Re-afforestation of waste land on and near the Station has continued, and four acres of *Cedrela toona* were planted and are well established. A method of pot-planting tree seedlings was introduced to the Station this season and a very promising nursery of about 22,000 trees is awaiting the break of the rains. These comprise *Callitris robusta*, *C. calcarata*, *Eucalyptus citriodora*, *E. robusta*, *E. rostrata*, all species recommended for the Makwapala conditions by the Chief Forest Officer. The pots in which each seedling is planted are of lightly burned clay about 5″ high by 4″ diameter internally. The idea is to plant the whole pot at the break of the rains and so avoid damage to the seedling roots. They are very inexpensive, 600 being made per day by three boys and a piccanin.

*Rotations.*—The cropping scheme for the season was as follows :—

| | | *Field.* | | *Field.* | | *Field.* |
|---|---|---|---|---|---|---|
| Rotation | I. | Cereals 1 | Cotton | 10 | — | |
| „ | II. | Maize 2 | ½ Tobacco<br>½ Pigeon pea | 11 | Cotton | 8 |
| „ | III. | Maize 3 | Cotton | 12 | ½ Tobacco<br>½ Pigeon Pea | 7 |
| „ | IV. | Cotton 4 | Fibres-Oilseeds | 5 | Miscellaneous Pulses, etc. | 6 |

There is little to note about the rotations which has not already been reported, except for the behaviour of the tobacco and of the pigeon pea (*Cajanus indicus*).

The tobacco plots came very near to being the best in the district and aroused considerable and favourable comment. There is little doubt that cotton is an admirable rotation crop for tobacco.

The pigeon pea was of very great interest. In a corner of field 7 the pan is particularly bad and erosion has removed most of the surface soil. In spite of this a fair stand of *Cajanus indicus* was obtained on this patch, and its growth, though admittedly not so good as on the rest of the plot, was by no means bad. The whole of the *Cajanus indicus* has been ratooned and will be allowed to occupy the land for another season. In addition, it is proposed to plant up the balance of fields 6 and 7, and possibly fields 4 and 5 also, to this crop. These are the worst fields on the farm and should form an excellent medium for observation of the effects of this crop on the soil.

A bush form of *Canavalia*, obtained from the West Indies by Mr. Lochrie, promises to be a useful addition to the farm crops. It was first tried at Port Herald last season, where it did well. A trial plot in field 6 has done almost equally well and showed indications that it is nearly as good as *Cajanus indicus* in dealing with the unsatisfactory conditions of the soil at Makwapala.

### Field Experiments.

Part of field 4 and of field 8 were used for plot experiments. Spacing, and ridge and flat experiments were sown in field 8 in repetition of last season's work, a set of manurial experiments in field 4. Over-the-Top B was used for all plots, which were laid out in a half-drill eight times replicated strip array.

The spell of hot dry weather immediately following their planting combined with extensive millipede attack reduced stands so considerably that nothing could be done but attempt re-sowing when the rains recommenced. Almost perfect stands were obtained on all plots with the second sowing, but were so late as to be useless.

All that can be said about these sets of plot experiments is that they were an excellent demonstration of the uselessness of late-sown Over-the-Top under the Makwapala soil and climatic conditions. The amounts of seed cotton picked were negligible.

A comparative trial of Over-the-Top B, with the two sub-strains B-30-13 and B-30-1, were also sown in field 4. The plots were very irregular owing to the drought which followed their sowing, and at least 50% of the seed did not germinate until the rain of January 7th. Once the plots got away growth was fair, and up to March the outlook was not unpromising. Continuous records were kept as in previous seasons. The wet cold spell in March affected the plots adversely, and with the cessation of the rains the bad soil properties of field 4 showed their maximum effect. Growth of cotton throughout this field had compared very unfavourably with that in fields 10 and 12, the first of the fields on the farm to be ridge terraced. Field 4 was originally old native gardens, which no doubt did not help matters. Leaf reddening and shedding became severe, all three strains cropped very badly, and there were no discernable differences between them. It was decided that no reliance can be placed on any of the records obtained and that none are worth publishing.

The failures recorded above may be attributed without hesitation to bad soil conditions above all else. Fields 4 and 8 both exhibit in large degree the lateritic ironstone pan formation which has gone on since the Station was cleared, and this, in conjunction with the long wet spell in March, formed the main reason for the failure. The lower fertility of field 4 intensified matters in that field. The early rains should have been enough to provide fair stands even though drought followed, and their failure to do so must be ascribed to poor water retaining and lifting powers in the soil. Examination of root systems before uprooting gave strong indications that cotton was entirely

unable to cope with the pan and had been reduced to surface feeding only, and it would appear that the advantages of ridge cultivation reported last year may be due to this.

Research into the reasons for failure of the cotton crop at Makwapala must be directed towards soil investigations in this coming season. All the indications point to the intense insect attacks from which the crop suffered being in large degree secondary to factors affecting both the crop and its pests, and lead to a conclusion that attempts to deal with the insects direct can only be palliative in their effects.

When means have been discovered whereby the soil conditions at Makwapala can be ameliorated so as to obtain a more healthy root development, or, alternatively, when a strain of cotton can be found more fit to cope with the conditions as they are, it will probably be found that certain of the insect problems, almost certainly that of the boll-worms, will solve themselves.

## Cotton Breeding Work.

*Farm Bulk Sowings.*—Over-the-Top mixed bulk was again used as the main cotton and gave results strictly comparable with those obtained last season ; 192 lbs. seed cotton per acre as against about 200 lbs. per acre last year. These results may again be compared with those obtained from this strain outside the Station under better soil conditions, which in general may be given as about 400 lbs. per acre, *i.e.*, double last year's yield.

The comparatively low yield may be again attributed to the two factors mentioned in last year's report, viz., the laterisation of the subsoil and the loss of surface soil due to erosion. Lines on which these are being attacked have already been discussed.

*Increase Bulks of Selected Strains of Over-the-Top.*—Two of last year's preliminary bulks were sown, B-30-1 in field 10, B-30-13 in field 12. These two fields are quite comparable so far as soil fertility is concerned, both having been ridge-terraced in 1926. The growth and cropping was decidedly better than in fields 4 and 8 where soil conditions leave much to be desired and poor stands were the main outstanding feature. B-30-1 gave nearly 300 lbs. seed cotton per acre, and in view of the better staple of this strain it will be re-tested against the ordinary bulk with a view to its replacing the latter should Over-the-Top continue to be planted.

*Progeny Rows and Observation Bulks.*—These were sown in field 9, N. side as follows :—

Bulk U.4 from Makwapala crop, 1927/28.
Progeny rows from Makwapala crop, 1927/28.
Selfed Bulk from Gatooma.
Unselfed Bulk from Gatooma.
Bulk An.12 from Makwapala crop, 1927/28.
Progeny rows from An.12 Makwapala crop, 1927/28.
Cambodia Strains from Gatooma.
Bancroft Strains from Rustenburg.
Bancroft Strains from Gatooma.
Nyasaland Upland selections from Chikwawa.
Local Kidney Cotton.
Ishan from Nigeria.

Foster Whitehall G was sown to provide a jassid control as suggested last year.

U.4 was the outstanding cotton on the block. Rather less than ½ acre gave 291 lbs. seed cotton, 200 of which was clean and white, and it would appear that in this strain we have a cotton which can cope with bad conditions more efficiently than will Over-the-Top. In fact, if it had not been for the performance of this strain, the outlook for cotton at Makwapala would have been much blacker. The strain's performance greatly impressed a number of visitors to the Station at picking time.

Some attractive single-plant selections have been made, with halo lengths ranging from 28 mm. to 31 mms., and the performance of these this coming season and of the bulk, which will be given an extensive trial, is being looked forward to with considerable interest.

Of the other strains only An.12 gave any crop worth mentioning, and this fell far behind U.4 in performance.

The Nyasaland Upland Selections and the Bancroft strains failed on the score of lack of jassid resistance, and were discarded. The local Kidney cotton and Ishan both failed to crop, the only thing worthy of mention being that Ishan is probably jassid-resistant.

Cambodia was of interest in that it confirmed the deductions made from the Over-the-Top plots on the score of bad soil conditions. Up to the close of the rains this plot looked most promising, but directly the surface soil commenced to dry it went right off, and the final crop was negligible. The lateness of this strain is greatly against it succeeding under the conditions now prevailing at Makwapala.

A few single plant selections of An.12 and Cambodia have been retained but none are particularly promising.

### Insect Pests.

The incidence of the pests was very like that of the previous season, and no points of interest other than those previously reported were recorded.

Until studies of the root development of U.4 and Over-the-Top have been made and the results of attempts to improve the soil conditions known, it seems unlikely that anything further of interest in connection with the pests will be noted.

## Port Herald Cotton Experiment Station, Report for the Season 1928/29.

*Season.*—Well distributed rains throughout the planting season gave Port Herald a most excellent start, and though the late rains usually expected in July were delayed until the first week of August they came in time to do the crop much good. Altogether it has been a most excellent year for the Lower Shire, and the result is not only a record crop for the Port Herald Station, but an expected record crop of 5,000 bales for the native growers.

*General.*—The work of the Station has continued on lines similar to those of the past two seasons, and there is nothing new to report about the rotation crops in general.

Two new introductions have been made which show promise, namely, a strain of sorghum from the Premier Cotton Estates and the *Canavalia* mentioned in last year's report. Further work will be done on both.

The Sabul plough tried out at Makwapala has now been introduced to Port Herald and has proved a great success. Plans for further stocking of the Station with cattle-drawn implements are under consideration.

The bricks of which the farm building is constructed were observed to be weathering rather badly, and in order to preserve them the building has been given several heavy coats of whitewash. The measure promises to be successful.

The well sunk on the Station has continued to give satisfaction, and two months ago (August) the water depth suddenly increased by 18 inches. The reason for this is obscure, and the Geological Survey are unable to cast any light on the phenomenon. It is to be hoped that the reverse, a fall in the water level, will not occur.

In view of the importance of the results at this Station an increase in the cultivated area to 60 acres is being contemplated. This could easily be done at small cost since no heavy clearing is involved. On

the present two-course rotational layout this would provide for 30 acres of cotton annually.

The problem of bulking improved seed stocks for the Lower Shire area is also under consideration. After due thought it has been decided that this can probably be most economically done by organising a co-operative cotton-growing scheme on the 4,000 acres of native gardens surrounding the Station.

This area is rather well delimited by a line of hills, two rivers, and a block of privately owned land. It consists of a stretch of level soil equal in quality to that of the Station and is well populated. The District Commissioner is very kindly taking a census of the population and gardens of the area and plans are being formulated for putting the scheme into operation.

### Field Experiments.

In marked contrast to Makwapala the field experiment work at Port Herald has this season given excellent results.

A series of spacing, time-of-planting, and variety trials were laid out on the lines of last year's work.

The eight times replicated half-drill strip layout was used for the spacing and time-of-planting experiments, but a six times replicated randomised plot layout was used for the variety test on account of the large number of varieties under trial.

Profiting from last year's experience, all strains which had showed jassid susceptibility were discarded.

Rows of jassid-susceptible Foster Whitehall G were used as a control, but were planted too late to breed up the pest. It was a non-jassid year at Port Herald, some minor attack in the early stages rapidly disappearing.

*Spacing Experiment.*—Strain Foster Whitehall H-3-2 was sown in holes under good conditions ; sufficient seed was not available for the continuous drills of previous years. Sowing was done on February 15th, and the plots were completely thinned to the requisite spacings by April 4th. Good stands were obtained. Growth throughout was healthy and normal for the strain, a very small amount of jassid noticed in May rapidly disappearing. Topping by bollworms was severe. Observations in July were to the effect that nothing remarkable was to be noticed about the spacing plots. A considerable amount of defoliation occurred in late July, but regeneration was rapid when the August rains came. Pickings were taken on September 4th, 17th and 28th, and on October 7th and 19th. The plots were then uprooted.

The results of these trials are given in Table I.

TABLE I.

STANDARD SPACING 4′ × 2′. (ONE PLANT PER HOLE.)

| *Spacing.* | *Mean Plot Yields in lbs.* | *Mean Difference of Plot Yields.* | *S.D.* | *S.E.* |
|---|---|---|---|---|
| 4′×2′ (unthinned) ... ... ... | 15·38 | +2·88 | 2·52 | 0·89 |
| Standard... ... ... ... ... | 12·49 | | | |
| 4′×2′ (two plants per hole) ... ... | 15·26 | +0·88 | 2·85 | 1·007 |
| Standard... ... ... ... ... | 14·38 | | | |
| 4′×1′ 6″ (two plants per hole) ... | 15·79 | +0·49 | 3·18 | 1·12 |
| Standard... ... ... ... ... | 15·29 | | | |
| 4′×1′ 6″ (one plant per hole) ... ... | 18·26 | −0·12 | 1·92 | 0·67 |
| Standard... ... ... ... ... | 18·39 | | | |
| 4′×1′ (one plant per hole) ... ... | 15·15 | −1·69 | 4·24 | 1·49 |
| Standard... ... ... ... ... | 16·98 | | | |
| 4′×6″ (one plant per hole) ... ... | 17·54 | +0.72 | 2·56 | 0·90 |
| Standard... ... ... ... ... | 16·82 | | | |

The greatest increase over the standard is given by the unthinned spacing. This is a near approximation to the arrangement favoured by the Natives, and its possible significance is of interest.

There is no significant difference between the other spacings, and this being the third year that such observation has been made, the conclusion must be drawn that, within wide limits, at a 4 ft. row width, spacing has little influence on the Port Herald yields. Time of planting appears to be a much more critical factor.

*Time-of-Planting Experiment.*—This experiment was inconclusive last year owing chiefly to the fact that the Foster Whitehall strain G used suffered severely from jassid. In spite of this, the experience of the past two years, backed by that of the Natives, points to the inadvisability of January sowings being made at Port Herald. It was, therefore, decided to confine the times of planting to the range February 1st to April 1st, using February 15th as standard.

Satisfactory stands were obtained of all series, using Foster Whitehall H-2-2. The balance of the field was sown with this strain on February 15th. Observations of the various series in the field are most interesting. From being nicely graded in size according to age, the various series levelled up until there was but little difference in outward appearance to be seen between February 1st, 15th, and March 1st sowings. March 15th never quite caught up in growth, while April 1st was throughout noticeably behind the others. Pickings were taken

on September 3rd, 16th, and 27th, and on October 5th and 18th. The plots were then uprooted.

The results are given in Table II :

TABLE II.

STANDARD TIME OF PLANTING FEBRUARY 15TH.

| *Plot.* | *Mean Plot Yield in lbs.* | *Mean Difference of Plot Yields.* | *S.D.* | *S.E.* |
|---|---|---|---|---|
| February 1st ... ... ... ... | 11·65 | −0·96 | 1·39 | 0·49 |
| Standard... ... ... ... ... | 12·61 | | | |
| March 1st ... ... ... ... | 17·39 | −0·41 | 3·72 | 1·31 |
| Standard... ... ... ... ... | 17·80 | | | |
| March 15th ... ... ... ... | 18·06 | −1·17 | 1·95 | 0·69 |
| Standard... ... ... ... ... | 19·23 | | | |
| April 1st... ... ... ... ... | 12·96 | −6·73 | 2·92 | 1·03 |
| Standard... ... ... ... ... | 19·69 | | | |

In all cases the standard exceeded the variant in yield, though there is no significant difference between February 1st, March 1st and March 15th, and their controls. There is a definite disadvantage in sowing as late as April 1st.

The optimum planting date would this season appear to lie between February 15th and March 1st, probably the rain of February 25th would have been the best sowing rain of the period. Last season there were indications that the optimum date for sowing cotton was about March 7th, the previous season favoured February 15th. It may, therefore, be taken that somewhere between February 15th and March 15th lies the probable optimum date for planting cotton in most seasons. The Natives' sowing dates range between March 1st and May 1st for the most part, with probably the majority of the gardens sown after March 15th. It would, therefore, seem probable that an alteration of the general planting time on the Lower Shire by say one month, making the main sowings between February 1st and April 1st, would result in an appreciable increase in production. The difference between February 1st and April 1st amounts in the experiment to 50% in favour of the former.

*Variety Trial.*—Port Herald has possessed rather a superabundance of strains during the past two years, and though last season's experience with jassid enabled a number of strains to be discarded, the number retained as promising was still rather large. It was, therefore, considered advisable to devise an eliminating trial.

The number of varieties to be tested plus their standard amounted to eight strains in all, and from motives of economy it was decided to

abandon the half-drill strip layout in favour of a set of randomised plots giving six replicates per variety. The standard 5-row $\frac{1}{40}$th acre plot was used. The plots were planted on February 18th, supplied on February 26th, and good stands were obtained throughout. A slight initial unevenness of growth was quickly smoothed out and the whole series were thoroughly comparable.

The delay in arrival of the late rains rendered the comparison of the various strains of particular interest. Two—U.4/5 and G.C.664/1—stood out above all others. There was little to choose between them; if anything the Cambodia G.C.664 was the hardier. Both were markedly drought-resistant. Pickings were commenced on September 9th, and the plots were picked again on September 20th, 30th, October 10th and 21st, and then uprooted.

The results are given in Table III together with a comparison with the standard, Nyasaland Upland, as used in previous years:

TABLE III.

STANDARD. NYASALAND UPLAND B.C.G.A. SEED.

| *Strain.* | *Mean Plot Yields in lbs.* | *Mean Difference of Plot Yields.* | |
|---|---|---|---|
| Over-the-Top B... ... ... ... | 16·69 | −3·43 | S.D. of difference of any mean from any other mean 2·85. S.E. 1·16. |
| Standard... ... ... ... ... | 20·12 | | |
| Foster Whitehall H-2-2 ... ... | 20·25 | +0·13 | |
| Standard... ... ... ... ... | 20·12 | | |
| Foster Whitehall H-3-2 ... ... | 17·00 | −3·12 | |
| Standard... ... ... ... ... | 20·12 | | |
| Foster Whitehall H-3-8 ... ... | 18·75 | −1·37 | |
| Standard... ... ... ... ... | 20·12 | | |
| Andrews 12 ... ... ... ... | 17·30 | −2·82 | |
| Standard... ... ... ... ... | 20·12 | | |
| G. Cambodia 664/1 ... ... ... | 26·25 | +6·13 | |
| Standard... ... ... ... ... | 20·12 | | |
| U 4/5 ... ... ... ... ... | 28·06 | +7·94 | |
| Standard... ... ... ... ... | 20·12 | | |

There is a difference, possibly significant, in favour of Nyasaland Upland as compared with Over-the-Top. This agrees with previous information as to the unsuitability of the latter for the Lower Shire.

There are no significant differences between Nyasaland Upland and the Foster Whitehalls and Andrews 12, while the Cambodia and U.4/5 are definitely superior to all else.

There can be no hesitation in concentrating work on these two strains this coming season.

## Continuous Records.

Continuous records on the lines of previous work were kept on the three sets of field experiments. It is impossible, however, owing to pressure of other work, to complete the working up of these records in time for inclusion in this report.

Nevertheless, enough has been done to indicate that the main cropping at Port Herald depended largely on the August rains, and that the superiority of U.4 and Cambodia is largely due to their drought-resistance. Even without the late rains, they would have produced a fair crop, while the crops produced by the other strains depended in large measure on the regeneration which took place after these rains. The danger to late-planted cotton of a drought-susceptible strain, in the event of failure of the late rains, was pointed out by Mr. Sampson as long ago as 1921. It seems probable that in U.4 and Cambodia 664 we have now an insurance against such a contingency.

## Cotton Breeding Work.

*Bulk Sowings.*—The main cotton sown on the Station was Foster Whitehall strain H of which three sub-strains were sown.

Five acres of H-2-2 yielded 3,031 lbs. seed cotton, $2\frac{1}{2}$ acres of H-3-8, 1,684 lbs., and $2\frac{1}{2}$ acres of H-3-2, 1,752 lbs., all first grade. This average yield of 646·7 lbs. per acre is very satisfactory, but, as has been demonstrated by the variety test, is no more than would have been given by ordinary Nyasaland Upland. All three strains of H are remarkably like Nyasaland Upland in appearance and mainly differ from it in having a rather better ginning percentage and staple length, and an even habit due to their being pure lines.

*Progeny Rows and Observation Bulks.*—Field 9 and the S. half of field 11 were used for these plots. The range of types given in last year's report was sown, and in addition observation plots were sown of Bancrofts from Rustenburg and Gatooma, U.4 and Cambodia from Gatooma, and Ishan from Nigeria.

It may be said at once that U.4 and Cambodia completely eclipsed in performance all other types, the delay in arrival of the late rains emphasising the differences between these and other strains. As far as possible all seed produced on the breeding plots was selfed, using the flower tying method previously reported.

A large range of types was selected from the U.4 and Cambodia bulks for progeny rows, and satisfactorily large selfed and unselfed bulks of seed of each obtained. Both will be given an extensive trial this coming season both at Port Herald and at the new Domira Bay

Station which has just been opened, as well as, in the case of U.4, at Makwapala and on a large number of outside observation plots.

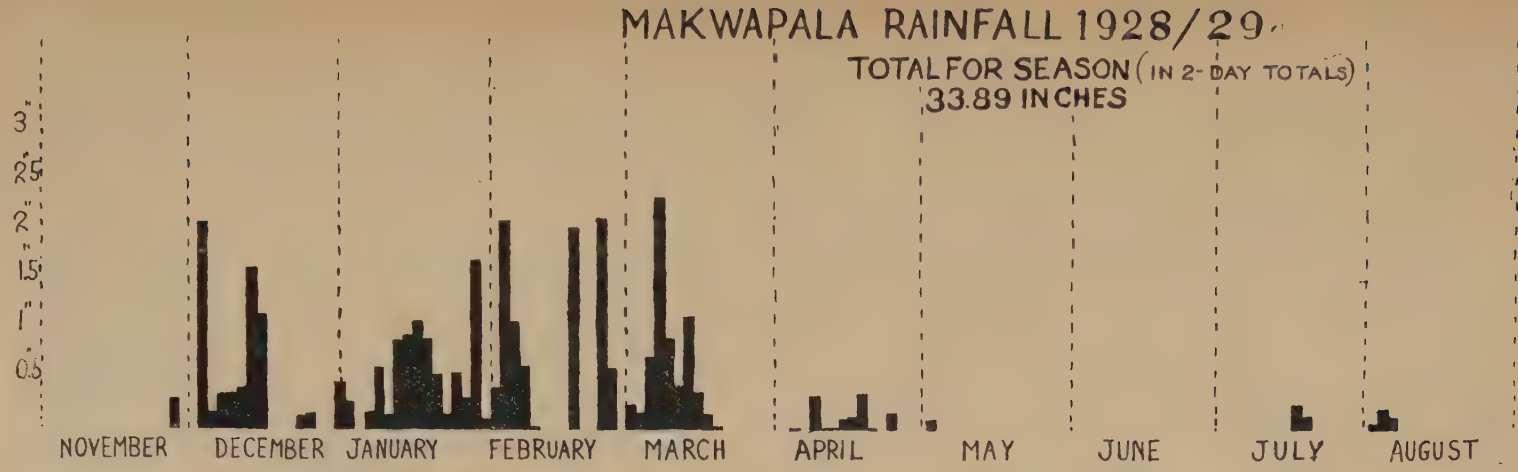
Several of the U.4 selections made by Mr. Lochrie last year have done well, and at least two will be bulked for comparison with the parent bulk.

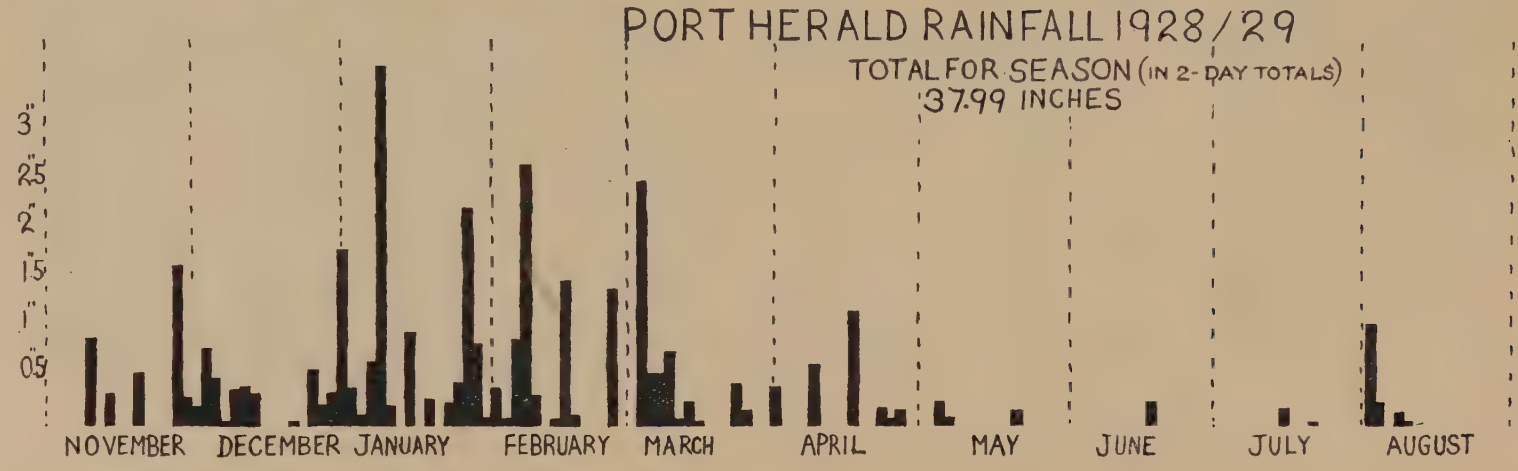
The Cambodia strains from Gatooma proved to contain a number of rogue plants apparently derived from an Egyptian cross. Efforts were made to destroy all such cross breds, and the replacement of the bulk by selected stock should complete the purification.

### Insect Pests.

It has been a non-jassid year at Port Herald, and the delay in the late rains enabled stainers to be controlled early. The amounts of stained cotton picked were so small as to be negligible. Bollworm attack was normal and suffered its usual decline into insignificance during July.

Aphis is the only pest calling for special mention. During the long dry spell preceding the August rains a heavy attack of aphis developed and it was particularly noticeable on the Andrews 12 plots. This strain is markedly inferior to U.4 and Cambodia in drought-resistance, in spite of its hirsute leaves and strong resistance to jassid, and it suffered so severely during the dry spell as to be almost completely defoliated. Practically its whole crop consisted of bolls formed when regeneration followed the August showers. The aphis was of direct value in emphasising the drought resistance of the better strains.


MAKWAPALA RAINFALL 1928/29
TOTAL FOR SEASON (IN 2-DAY TOTALS)
33.89 INCHES
0.5
1.5
2
2.5
3
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST


PORT HERALD RAINFALL 1928/29
TOTAL FOR SEASON (IN 2-DAY TOTALS)
37.99 INCHES
0.5
1.5
2
2.5
3
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST

# NIGERIA

## REPORT ON THE CORPORATION'S SEED FARM, DAUDAWA, NORTHERN NIGERIA, FOR THE YEAR 1929.

BY
G. BROWNE.

SUMMARY.

*Cotton.*—The yield over the 170 acres of cotton planted last season was 264½ lbs. of seed cotton per acre. Of the 36,560 lbs. of seed produced, 34,960 lbs. were sent to the Department of Agriculture, the balance, being considered unsuitable for distribution, was kept for cattle feed. The seed sent to the Department was issued in the Dan Ja area of Southern Katsina.

The first quality lint shipped home amounted to 14,722 lbs. contained in 37 bales. The brokers' report on it was, " Good Middling, Staple about 1⅛ inches, rather mixed with short and rather neppy, fairly strong. Value 140 on."

*Clearing.*—210 acres were cleared during the year, thus completing the original block of 480 acres, all of which is now under cultivation.

*Cropping.*—In 1929, 350 acres were planted in cotton, an increase of 180 acres on the previous year's figures. The seed sown was Strain D, a selection from native Allen, which came from the Government Experimental Farm at Maigana. The average seed-rate was 14 lbs. per acre. Two Avery cotton planters were successfully used. There were also planted 120 acres of Mucuna beans, and 10 acres cereals.

*Co-operative Farms.*—Three new farms were completed and are now tenanted, thus making six occupied by native farmers. A further five were cleared and cropped ready for handing over in the near future.

*Extensions.*—Application was made to the Native Administration for further extensions of land, amounting to 769 acres. Of this 684 acres will be ultimately cultivated.

### RECAPITULATORY.

The original area of the farm was 1,280 acres, but some was found unsuitable for agricultural purposes, so extensions amounting to 770 acres are being undertaken. In the first year, 120 acres were cleared and cultivated, of this 40 acres were cotton. One hundred acres were added in 1927 making 220 acres, which included

100 acres of cotton. In 1928, 170 acres of cotton were planted out of a total of 270 acres. During 1929, the farm has reached the figure of 480 acres, of which 350 acres are under cotton. The bulk of the balance has each year been put into beans (Mucuna) for green manure purposes.

### Clearing.

The total area cleared during the year amounted to 210 acres, the actual fields being shown on the plan of the farm attached at the end of this report.

The methods employed in clearing are more or less the same as those described in last year's report. A quantity of ordinary double-ended mattocks were however imported from England, thus enabling a man to dig round a tree and cut its roots with the same tool, without having to call for a man with a digger. The result is that one man can work at a tree and get it down unassisted.

### Cultivation (Breaking Land).

All the fields cleared were cultivated. In six of these fields and in part of another the land was all hoed over in the ordinary way, and ridged up in the dry season. The remainder of the fields to be broken up were dealt with by the method described in last year's report. This consisted in marking out the land in lines made by ashes or coloured earth (to contrast with the natural earth colour) where it was proposed to make the ridges, and then to hoe up the line so made as deeply as possible, and about 6 inches wide, roughly rather more than a hoe's breadth. Men can then ridge on to the broken surface from each side, thus making a straight and even ridge. They do not have to look where they are going so much as when ridging to a rope. As explained last year an additional advantage is that the two operations of breaking and ridging are thus combined. There is little or no difference between the fields cultivated thus and by the ordinary method of breaking, and then ridging later on. It may be asked why, if this method is so much cheaper and quicker, all the fields were not worked in the same way. The reason is that, in Nigeria, the period during which the ground is easily workable is so short that the important question is how to get the land worked with the labour likely to be available after the rains have broken, seeing that a considerable number of men, being either local or distant farmers, then leave to do their own cultivation. This fact constitutes the whole labour difficulty in the Daudawa area, and causes a labour shortage at the very time men are most wanted. A certain amount of hoeing and ridging must therefore be done during the dry season while men are

plentiful, though naturally the ground is not worked as deep then as during the wet season. When the opportunity occurs, however, another and deeper ridging is given, though probably after the crop has been planted.

CROPS.

*Cotton.* The average yield last season over the farm was not as satisfactory as was at one time thought probable, owing to a fairly bad attack of bollworm. This attacked the earlier planted fields and practically ruined the crop in them. Fortunately some of the fields had time to recuperate partially, and later produced quite a fair crop, though of course nothing like so much as had been previously expected, as all the five fields chiefly affected had extraordinarily good stands of cotton earlier in the season.

Two fields suffered from Leaf-curl badly in September and October, but recovered later and yielded a fairly good crop, considering the extent to which their early growth was stunted during these two months.

From the remainder of the fields, yields were much more normal, as was also the growth, though a tendency to run to wood was evident in certain fields where the alluvial soil was rich. It may be taken that round about 300 lbs. per acre of seed cotton was the average over the majority of the farm under cotton, and the fact that the general average only reached 264½ lbs. was due to the boll-worm attack and, to a certain extent, to the Leaf-curl mentioned previously.

The total amount of seed cotton from the main farm amounted to 45,088 lbs. This was ginned, together with the cotton from the Co-operative farms, and also that bought in from the neighbouring farmers who had been selected to grow the surplus seed available, under the partial supervision of the Corporation's officers. The seed-cotton from the Co-operative farms amounted to 2,751 lbs., while that bought came to 4,156 lbs., making a grand total of 51,995 lbs. This, when ginned, produced 36,560 lbs. of seed, of which 34,960 lbs. was handed over to the Agricultural Department for distribution in the Dan Ja area of Southern Katsina.

The seed sent from Samaru for the crop to be planted in 1929 was Strain D, a selection of native Allen from Maigana, and amounted to 7,500 lbs. About 4,700 lbs. of this was used to plant the Main Farm and, later, for supplies. The rest was allocated between the Co-operative farmers and neighbouring farmers, though it is not proposed to buy in the seed cotton from these farmers in the coming harvesting season as in former years, as the Agricultural Department do not consider that it can be accepted as pure.

The average seed rate per acre used for hand planting and for the mechanical drills was 14lbs., though 10 lbs. was nearer the mark by the former method. The Avery cotton planters, which were used for the first time with a view to shortening the planting period, were rather more extravagant, using about 16 lbs. per acre. This seed rate is really very moderate, it is understood, compared with many types of planters, however, and on the whole the planters were found quite satisfactory, the spacing being good and fairly regular. The seed was not de-linted, but liquid dung and ashes were used to make the individual seeds easier to sow by sticking down the fuzz. Initially both men and cattle were used as draught, but the work being found too heavy for men, cattle planted the remainder of the 47 acres by this means. A larger area could have been planted by this method, had more cattle been available. Balls' single-seed method was used to sow 10 acres in Field 5, principally to train labourers in the method in case the necessity for special economy in seed should arise.

Three spacings between rows were employed, 3 ft., 3 ft. 6 ins. and 4 ft., the last being on the ground where beans had been sown previously. This last spacing (4 ft.), will be eliminated in future, and 3 ft. and 3 ft. 6 ins. will both be retained for the time being. Spacing between plants was about 18 ins. A certain number of local women and boys were employed to assist in the planting, and they also helped with the supplying later on. Planting commenced on July 1st (which was later than was intended, owing to the lack of planting rains) and finished on the 26th of the same month. This was a much shorter period than in previous years, and consequently some little trouble was experienced in pre-planting and post-planting cultivation. Germination was good over the whole farm, though rather slow owing to lack of moisture at the time. Once the plants got started, progress was good, and the amount of seed used in supplying was not excessive. Two plants per stand were left when the cotton was thinned as has been the practice in former years. Flowering commenced about the middle of August, or six weeks after planting. The crop over the whole farm at the present time (the first week of November) shows promise of giving much higher yields than in any previous year since the farm was started, the stand being very even, flowering heavy and partly formed bolls and larger ones being numerous. The plants are extraordinarily free from any disease and from bollworm attack, although there are a few cases of the latter and of Leaf-curl. The cotton planted by the Balls' single-seed method, although planted late, looks healthy and fairly full of promise. (In passing, it may be said that the natives are showing a great interest in the single-seed planting.) After the cotton was well

rooted, the incidence of rainfall was fortunately very favourable and continued until past the middle of October, the final mulching being carried out up to the end of that month and a few days into November. The cotton in Field 6 is particularly good, and that grown on the land where the mechanical cultivation experiment was carried out last year is excellent.

*Beans.*—One ton of Mucuna seed, available from last year's crop after our own requirements had been met, was sent to the Agricultural Department for sowing purposes. Seven acres of last year's crop were retained for seed, and these produced 5,399 lbs.

In all 120 acres of Mucuna beans were planted for green manure. Owing to the poor quality of the soil in Field 5, one half of this was again put into beans. Planting was commenced on the 15th of May, and concluded on the 24th. Seed rate was 2 seeds per hole and the holes were 12ins. apart. Experimental planting was carried out with the Avery cotton planters, but with only moderate success ; it is hoped, however, that with more experience they can be made to maintain a greater degree of regularity, when planting beans. There was a very luxuriant crop in the majority of the fields, more so, however, in the old land than in the new, with the possible exception of Field 5. The best field is being harvested to provide seed for next year. All the rest have now been turned in and ridged over in preparation for planting cotton thereon next season. The work commenced on the 4th of September and finished on the 28th. They were turned in by the method described in detail in last year's report, *i.e.*, cutting and twisting the beans into a compact mass in the bottom of the row, and then ridging over them from each side, splitting the adjoining ridges. A light dressing before the cotton is planted in the following season consolidates them. It is a fairly costly business at any time, but if done before the rains end while the earth is soft, the cost is reasonable when it is remembered that the land is then almost ready for cotton, and, moreover, is manured. The 10 acres for seed production have to be left until the beans are more or less mature, and, after harvesting, are treated in the same way. As the rains have finished by then, the work is necessarily more expensive, the cost per acre being twice as much as for those turned in during the rains. It is hoped to increase the proportion of beans to cotton in future years to keep the farm in good heart.

*Millet.*—Eleven acres in all were planted with bullrush millet inter-planted with guinea-corn. The millet or "Gero," to use the Hausa word, was planted in early April and produced a good average crop, the total weight being 9,820 lbs. or about 893 lbs. per

acre. Spacing was 4 ft. apart in the rows to allow for inter-planting the guinea-corn. It has been since thought that even wider spacing would be beneficial. It was re-sown and thinned in May, and was harvested on the 30th of July. A native grain-store is being built in which the grain will be kept until food is not plentiful when it may be wanted for the labourers.

*Guinea-corn.*—The guinea-corn or "Dawa" was sown in May, between the millet, but owing to a strong crop of millet coming forward, and/or to the spacing being too close, as suggested above, it had rather a poor start. Later on, however, when the millet was cut, the guinea-corn forged ahead, and at the time of writing looks healthy and likely to produce a good crop.

*Rice.*—About 200 lbs. of seed were given us by the Agricultural Department for sowing in some "fadama" or marsh land. The idea had been mooted in a previous year, but at that time it was thought that shortage of water would prove fatal, and the scheme was dropped. This rice is an exotic variety and at present is suffering from lack of moisture. Perhaps an indigenous variety might answer the purpose better. It will be interesting to see what the result will be, for rice as a crop would prove very useful for food for labourers, and would utilise the fadama land (of which there is fortunately not much on the farm) which is unproductive of other crops.

### Cotton Seed Distribution.

As will be seen in a foregoing paragraph, 34,960 lbs. of seed fit for distribution were produced from all sources, that is to say, from the Main Farm, Co-operative Farms, and from the farms of those farmers who had been selected to grow the seed which was available after the above farms had been sown and supplied. The seed was put into 100 lb. bags, and was sent on the instructions of the Agricultural Department to Dan Ja, for subsequent distribution to native farmers in that locality. The Department anticipate that it will be possible to buy in the seed cotton grown from this seed, and to release the resulting seed for general distribution in the following year.

In addition to the seed thus issued to the Agricultural Department there were 1,600 lbs. which were considered to be unsuitable for distribution, and these were retained for cattle feed.

### Labour.

Of all the factors connected with the extension and success of this farm at Daudawa, labour is at once the most important, and, in a way, the most interesting. The task consists in gradually building up

a permanent labour staff. It is composed partly of men who are passing by and call in for a week's work or so, and who, because they have nowhere else to go, or because they own no farm to which to return when the rains break, finally decide to settle down at Daudawa. The attractions to them are steady work, water, and practically a guaranteed food supply, for in times of famine every effort is made by the Corporation's officers to provide food for the labourers. Then there are the men who have been with the Corporation since 1926, but think that they would like a change. They go away, and sooner or later, in nine cases out of ten, they return bringing with them one or two more men. An instance is that of a man who left Daudawa in July, 1928, worked on the railway and elsewhere, and returned in October, 1929, bringing his wife and three more labourers who wished for permanent employment.

The average daily attendance for September, 1928 (admittedly a bad month) was only 67, while in September, 1929, it was 155. Taking the 12 months from September, 1928, to August, 1929, inclusive, the average daily attendance throughout the year was 118. While it is impossible to take on all the casual labour available during the dry season, a plan is being tried of taking men either on half time or at a reduced rate of pay, in the hope that some of these may, at the close of the dry season, wish to remain at Daudawa as permanent labour. This only refers, of course, to purely casual labour ; men with wives, local farmers, and ex-soldiers are taken on at all times. Undoubtedly the presence of an ample supply of water has had a very beneficial effect on labour ; indeed it might safely be said that without it Daudawa could never have grown to what it is to-day. It is satisfactory to record that guinea-worm (a water-borne disease), though still prevalent is not so serious as formerly. There seems to be more casual labour available during the last two years, due to a certain extent to the amalgamation of, and the economy practised by, the large tin mining companies, who used to absorb so much of the labour of the Northern Provinces.

The gradual extension of the labour lines has improved the accommodation, though, in this country, rot and wastage of anything made of grass or timber is extremely rapid. A recruiter is still employed who acts as a sort of liaison agent between the labourers and the Europeans, headmen, and the local village heads, etc.

The contract work referred to in last year's report has proved a great success in certain kinds of work, and attempts are to be made to apply it to other work, such as the complete operation of clearing.

### Cattle.

In the last annual report it was stated that the cattle had been lent to the Agricultural Department at Samaru. Later, two more men were sent there for two months' training, and they then brought the cattle back to Daudawa, where they have been working ever since. A certain amount of ploughing has been done by their aid, also cotton-sowing by drill, and some intercrop cultivation. It is proposed to procure more cattle as soon as it is certain that the farm is definitely free from tsetse fly. Those at present here have not done so well, as far as health is concerned, as they might have done. A cattle shed and fodder house were built and these have proved very satisfactory. The Egyptian plough which was fitted with breasts did very good work after extensions had been fitted for working in the 3 ft. ridges. The cattle came in very useful for working with the cotton drills, but, unfortunately, the fact of our having only one pair meant one drill lying idle, as the work was found too heavy for men. When not working in the field the cattle are used with the trailer, now fitted up as a cart, for carrying stone, sand, wood, and water etc.

*Cattle Kraaling.*—There was no difficulty in attracting Fulani cattle to eat the cotton sticks. Food was scarce in the bush and the Fulani were glad to bring their cattle to Daudawa, where there were both food and water. Over 200 cattle grazed the cotton fields for some 5 or 6 weeks, the night kraal being on Field 5, where the soil is of very inferior quality. The kraal was moved every second night to an adjacent piece of ground to spread the effect somewhat. Many more cattle were waiting round the farm, and considerably more than the above number could have been obtained, had there been sufficient food. There was no suggestion of any payment being required, whereas in previous years 1/- per 100 cattle-nights was paid.

### Mechanical Cultivation.

There is nothing to report this year in connection with mechanical cultivation. The Fordson tractors are not in good order, so, unfortunately, it is not possible to continue the experiment. It may be said, however, that the part of Field 6, which came under deep ploughing last year, is certainly in excellent condition and shows up as the best part of what is, at any time, a good field. It is unfortunate, for many reasons, that the experiment was not carried out on a field of an average or even inferior grade of soil.

### Windbreaks.

The windbreaks planted last year on the farm have made good progress, few of the 1,800 seedlings having failed to survive. It

may be remembered that the trees planted were *Dalbergia Cesa* and Eucalyptus, there being a predominance of the former. A strip was also planted near the Sokoto Road, and this too has done well. Nothing further has been planted during the past year.

### The Ginnery.

All the cotton crop of Daudawa was ginned in the Corporation's ginnery here, as was also the cotton from the Co-operative Farms and that brought from neighbouring farmers selected to grow cotton from seed issued to them.

In all 51,995 lbs. of seed cotton were ginned, and yielded 15,232 lbs. of lint, equal to a ginning percentage of 29·3 ; the seed was 36,560 lbs. or 70·3%, and the waste 203 lbs. or 0·4%.

Certain minor improvements were made to the gin before the season commenced and these reduced the waste percentage from last year's figure. With the exception of the bearing of a loose pulley on the saw shaft getting very hot and consequently melting part of the " bush " no trouble was experienced. The press is rather slow for the gin, and the tendency is for work to be held up on occasion for this reason. The ironwork on the ginnery and also the machinery were painted at the end of the season.

The Robey engine ran perfectly and the water was at all times sufficient.

A grindstone, capable of being driven from the line shafting at the ginnery, has been erected. This will be a very valuable asset during the clearing season.

### Waterworks.

Little or no trouble has been experienced with the pumping engines. These Hot Air engines formerly gave a good deal of trouble, especially as regards the driving chains, but since stronger wheels and chains were fitted, the latter also having more links to the foot than the old ones, this has ceased. The only trouble now is with the badly lubricated bearings at all moving points, but this also to a much less degree than previously, the stronger wheels and chains appearing to have a steadying effect.

A new and more extensive water supply scheme has been sanctioned, the material for which is now ready for erection. This provides for a vertical steam boiler and pump, an elevated water tank to hold 1,600 gallons, to ensure a gravity feed to the labour lines, ginnery and Co-operative Farm site.

The filter beds did not turn out to be a success, firstly because they became silted up in the floods, and secondly, because the sump was at

the same level as the river bed and the water would not percolate through the filter beds quickly enough to feed the pump.

A tank has been built adjoining, and connected by an underground pipe to, the engine house of the ginnery. This has a small sub-section, which can be separated from the larger tank and filled therefrom in times of water shortage. The larger tank, which is filled by the superfluous water supplied to the village tank during the day, can also be drawn on by means of a return pipe to the village tank, when the pumps are not working. The underground pipe connects the small tank with another placed immediately below the steam boiler, and thus automatically keeps a constant level for the boiler feed. The large tank holds about 3,300 gallons.

### Buildings.

A cattle shed has been erected containing an open box with provision for tying up about 7 or 8 cattle, and a smaller box for the accommodation of a sick beast or an unruly one. At the end a small fodder house is attached. The cattle boxes have sunken floors to hold a greater quantity of manure.

A machine and implement shed has been built nearby containing seven bays. Both this and the cattle shed are of laterite with pan roofs, and are built on the outcrop in Field 5 behind the ginnery. The mosquito house at No. 1 Staff house has been done away with, as borers and white ants had destroyed the woodwork, and it was not considered necessary to go to the expense of re-building. Permanent material from it was stored, and part of it subsequently used for building a carpenter's shed, where timber, cement, etc., can be kept. This shed is built of mud, which was later tarred and roofed with pan. It is situated on the residential site near the staff lines.

The roof of the farm store which had given trouble during the rains was taken off and the pitch increased. Sawn timber was used in re-roofing, which gave a more even " lie " for the pan. A separate room was built inside to store new tools and farm supplies.

The frontal wall in the dining-living room of No. 1 Staff house was moved forward 8 ft., thus making a more commodious room. No structural alterations were necessary. Minor other repairs were carried out during the Manager's absence in England. At the time of writing the masons are making laterite foundations for the co-operative farmers' houses to be built this season, namely five houses for new farms made last season and one for farm C. 1, which is as yet untenanted. The walls of these houses are built of mud balls by native contractors on the foundations built by our own masons. The ground plan and general design are the same as last year.

A native-type grain store is in course of erection. This will be divided by a partition into two compartments to separate the millet and guinea-corn.

Twenty-nine round houses for the accommodation of labourers, etc., were built during the year. Twenty-six of these were in the labour lines, and three in the staff lines, one of the latter being a stable. Many of these were replacements of old houses which were no longer habitable. There are now 66 houses in the labour lines, of which there remain only seven which have not mud walls.

### Residential Site.

The trees, both ornamental and others, on the residential site, have grown very quickly, and are kept carefully pruned. A number of seedlings were reared, the seed being the Pride of Barbados, which was obtained from Samaru. These seedlings were planted along the drive at the beginning of the wet season to form an avenue.

A banana grove is providing several bunches of fruit, and is expected to give a large supply another year. The citrus and other fruit trees were planted out in orchard formation, but, of course, are not bearing yet. The Lima beans have not done at all well as a cover crop among the fruit trees, and it is probable that Mucuna or groundnuts will be planted next year.

The vegetable garden near the house does fairly well, but another one has been made to the south where it will be possible to irrigate a little without the danger of mosquitos. Vegetables are very difficult to grow here at the best of times.

### Co-operative Farms.

As in previous years, the farms which were cleared in the previous season, are put into crops and the houses built in the following dry season, and the farms then handed over to selected tenants. At the time of writing last year's report, three farms were in full occupation, while on three more the houses were being built in readiness for occupation ; C. 1 farm, owing to the fact that it contained a laterite outcrop, was cropped along with the main farm, and was untenanted. This latter farm has now been extended to compensate for the outcrop of laterite and a house is being built, preparatory to its being taken over by one of the chief headmen. The houses built for the second trio of farms were of a different type, being of a rectangular shape with a span roof. Each contains two rooms and a central connecting hall. These houses have the added advantage that it is within the ability of the farmer to re-thatch them without calling in a thatcher. Each farm has, to commence with, $4\frac{1}{2}$ acres cultivation (2 acres cereals and $2\frac{1}{2}$ acres

of cotton), 5 acres of bush for grazing or extension, and ½ acre for a homestead. Extensions have been made in B. 2 and C. 2 by the occupying farmers, B. 2 being almost cleared to its full extent. This farmer is hoping to go in for cattle cultivation in conjunction with the farmer of C. 3. None of the farmers did any green manuring last year, but all had Fulani cattle kraaled on their farms. It is hoped that a portion of their farms will contain some beans for green manure in the coming season. All the farms gave good yields of bulrush millet interplanted with guinea-corn ; no shortage of food was experienced, in fact some was sold. As regards cotton, the average yield over all the six farms was 214 lbs. seed cotton per acre. The average was reduced by the three new farms, which were not only planted late, but all contained laterite outcrops of varying sizes. One of the three occupied farms, B. 2, averaged 480 lbs. per acre. As in former years, the seed cotton was purchased by the Corporation at the highest local price, and was ginned along with that from the Main Farm.

Five farms were cleared during the dry season. Four out of the five were made up to 5 acres of cultivation, instead of the usual 4½ acres owing to outcrops. All were planted on the same lines as before. This year there are in all 29½ acres under cotton on the Co-operative farms, which provide a useful contribution to the general acreage sown with special seed. The houses now in course of construction are on the same plan as those of last year. When the new water scheme is finished water will be brought into the centre of the Co-operative site, and will prove a great attraction to farmers. At present they have to carry their water over half-a-mile.

Ex-soldiers are given first chance of farms, providing that they have given satisfaction while working on the main farm. Five out of the six farmers at present occupying farms are ex-soldiers.

### Meteorological Notes.

Rain fell for the first time on the 31st of March, 1929, and ended on the 17th of October. Planting rains were late, although a fair quantity fell during the month of May. The incidence throughout the early part of the season and again later on was good, but planting was held up for a matter of 10 days. There were occasional heavy rains which caused some washing, but nothing more than usual. The months before and after the rains were, as is usual, very hot and sticky.

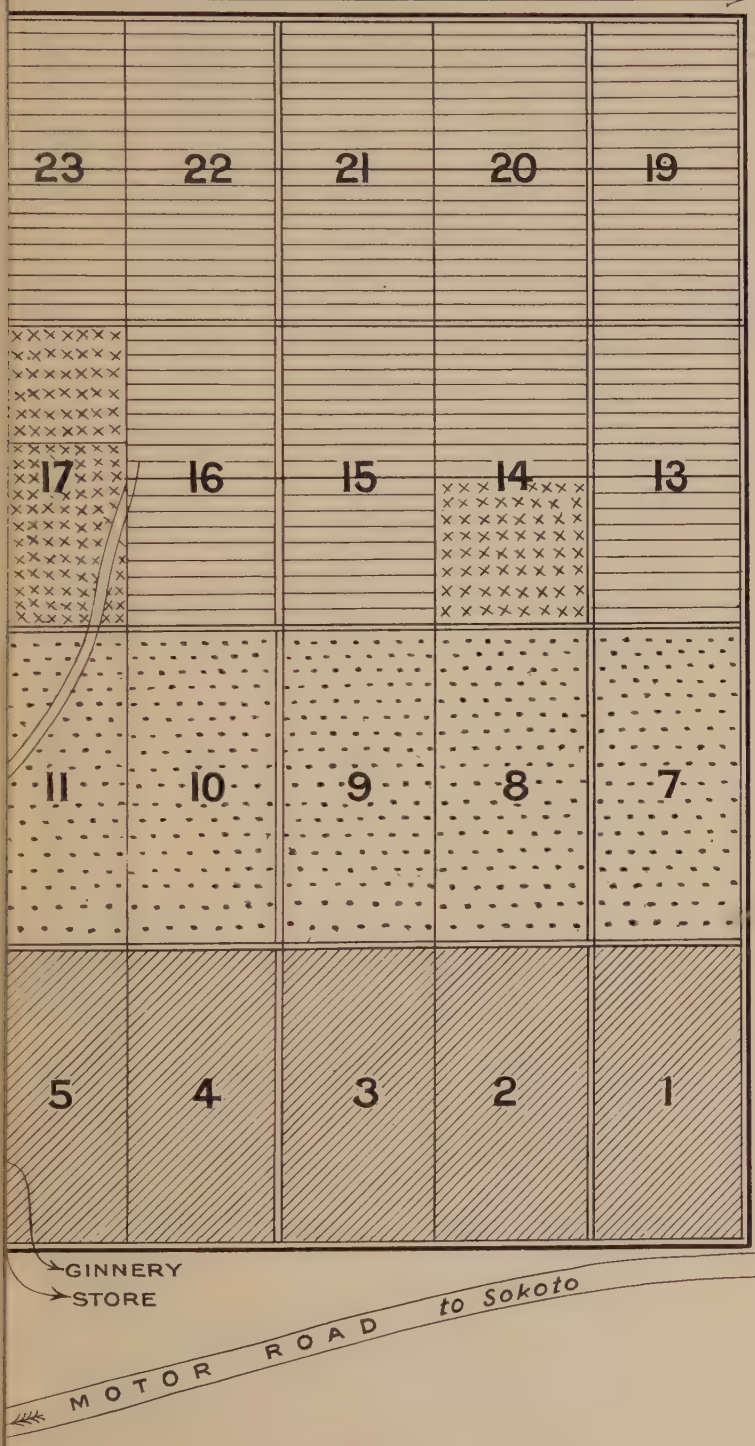
The rainfall in the months of May, July and October, exceeded that in any of the same months in previous years, and was well above normal, though not equal to that of 1927, which was the record for some years past in Nigeria.

*General.*—Mr. H. Hutchinson, a farmer holder of one of the Corporations Studentships, was appointed as Assistant to the Manager and arrived in September, 1928.

The Emir of Katsina continued to visit the farm, and was always especially interested in the Co-operative farms and in green manuring. Among other visitors have been the Director of Agriculture and the various members of his staff, who have been very helpful in every way, the late Resident, Zaria, Mr. E. H. B. Laing, The District Officer, Katsina, and Mr. Adams of the B.C.G.A. who brought with him M. Hesling, le Directeur de l'Association Cottonière Coloniale, who was touring West Africa studying cotton-growing. A number of other visitors who have come long distances to see the farm are native farmers, who are always encouraged to inspect the fields.

In the surrounding districts, the present year is not only a good cotton year, but much larger areas are under cotton. This appears to apply generally.

The health of the European and native staff has been fairly good, with the exception of the usual attacks of fever and, in the case of the natives, guinea-worm, though, as stated above, there are not so many cases of the latter this year as formerly.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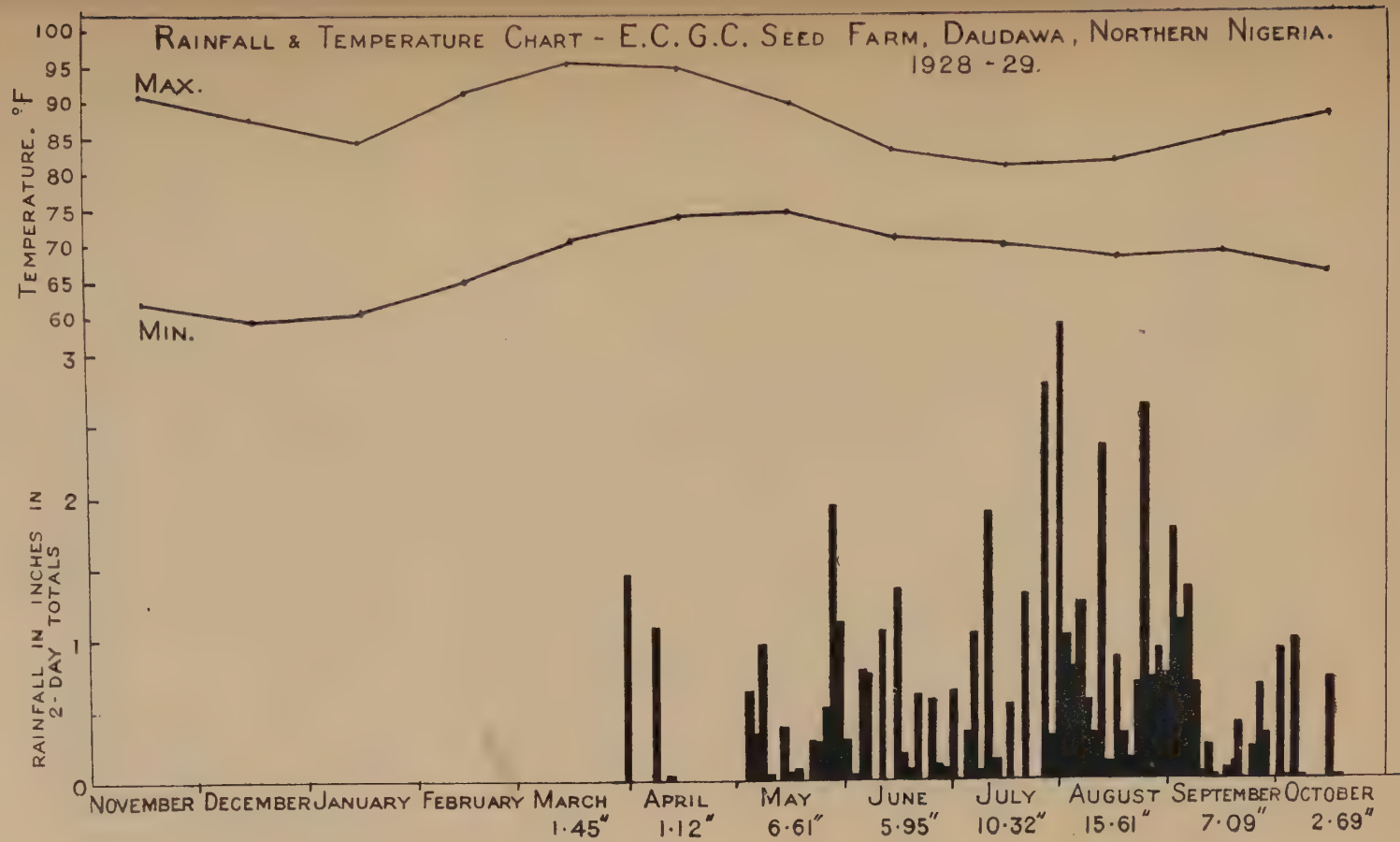
STORE
MOTOR ROAD to Sokoto


RAINFALL & TEMPERATURE CHART - E.C.G.C. SEED FARM, DAUDAWA, NORTHERN NIGERIA.
1928 - 29.
MAX.
MIN.
TEMPERATURE. °F
100
95
90
85
80
75
70
65
60
3
2
1
0
RAINFALL IN INCHES IN 2-DAY TOTALS
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH 1·45"
APRIL 1·12"
MAY 6·61"
JUNE 5·95"
JULY 10·32"
AUGUST 15·61"
SEPTEMBER 7·09"
OCTOBER 2·69"

# FIJI

## REPORT ON THE WORK OF THE COTTON EXPERIMENT STATION, SIGATOKA, FOR THE SEASON 1928-29

BY
R. R. ANSON.

During the season under review the climatic conditions have been far from favourable. The rainfall, though not so heavy as far as individual showers were concerned, was far more continuous this year than it was last year. Ninety-one wet, and forty-one dull and humid days were recorded, and the cotton plants had many set-backs owing to excessive moisture and the dull cloudy days experienced at the time when they were putting on flowering squares. The shedding of flowering squares and young bolls was most prevalent during the months of March, April, and May, and in consequence the crop is at least two months later in reaching maturity than it would have been under normal conditions. At the time of writing not more than half of the seed cotton from the New Guinea Kidney Hybrid variety has been picked. Consequently only the following interim report can be prepared in time for inclusion in the Corporation's annual publication of collected Reports from Experiment Stations.

It is very encouraging to see how well the New Guinea Hybrids have stood up to the excessively wet season. In many instances heavy crops are anticipated. The quality of the cotton is much better in class this year, and although the staple still remains somewhat irregular, it is hoped that this will in time be rectified by careful selection.

### Sea Island.

The growing of Sea Island cotton was confined to the West coast of the main island between the districts of Cuvu and Ra, and a small quantity that was grown on the islands of Mbengga and Vatulele.

The continuous rains and cloudy weather proved disastrous to the crop, and during the last week in January about 50% of the area planted was completely washed out by heavy rain accompanied by strong wind. On this account, and the generally unfavourable weather at the time of picking, the yield of seed cotton obtained per acre will be very low indeed. Sufficient seed was distributed for the planting of 900 acres, and up to the present time only 90 bales of 350 lbs. have been received at the Lautoka ginnery.

The seed from the increase plots of selection S.17 was issued to six or seven Indian growers occupying isolated positions in the Magere section of the Ba district, and also to two of the tenant farmers at Camboni. All of these growers were visited during the middle of June and further bulk selections were made. Most of the seed from these selections has again been distributed to the same small community of growers, and some of it is being given out to an Indian School at Lautoka and to an Indian grower at Mulaqereqere. Further plant selections will be made during the coming season in order to keep this strain up to type.

With the exception of two lines planted with seed obtained from re-selected plants from S.17, no Sea Island will be grown at the Station. Small samples from S.17 bulk selection together with some from the general bulk lot were taken at various times during the season and tested for lint index, ginning percentage, etc., and the following table gives the results from these tests :—

| *Date.* | *Sample.* | *Wt. of 100 Seeds. gms.* | *Lint Index.* | *Ginning % taken from 100 gms.* | *District.* |
|---|---|---|---|---|---|
| 7/8/29 ... | S.17 | 10·66 | 3·64 | 25 | Magere |
| 7/8/29 ... | Bulk | 11·40 | 3·58 | 23·5 | ,, |
| 16/8/29 ... | S.17 | 11·14 | 3·97 | 25·75 | Lautoka |
| 16/8/29 ... | Bulk | 11·34 | 3·80 | 25 | ,, |
| 21/8/29 ... | Bulk | 11·88 | 3·28 | 24 | Magere |
| 21/8/29 ... | S.17 | 12·05 | 4·07 | 25·75 | ,, |
| 26/8/29 ... | S.17-1 | 11·18 | 4·29 | 25·75 | Lawaqa |

The Lautoka ginnery ceased receiving Sea Island cotton on the 15th of October, and all plants were required to be uprooted and burnt by the 31st of that month.

### New Guinea Kidney Cotton.

As stated in last season's Report, all cotton growers who are situated in the Sigatoka river valley were issued with seed from increase plots of the New Guinea Kidney Hybrid cottons. This was rather rushing matters, but could hardly be avoided, and was brought about by the small demand for Sea Island cotton in the English markets.

There was not sufficient seed from any individual plant selection to supply requirements for the whole of the valley. It was, therefore, decided to divide the valley into four sections, and to issue each section with seed from increase plots of the four best plant selections. This did away with the necessity for any Sea Island being grown in the district, and lessened the chances of mixing either in the field or at the ginnery, as it enabled the whole of the Sigatoka valley to be planted with the new type.

During the months of February, March, and April, crops in most of the areas were severely attacked by jassid, and at this time growers seemed thoroughly disgusted with the new variety, and wanted to revert to the growing of Sea Island. The jassid disappeared with the finer weather in June, and plants put on a completely new growth, squares formed in hundreds, and in a number of cases crops, which at first appeared to be complete failures, are now producing up to 2,000 lbs. of seed cotton to the acre.

*Multiplication Plots.*—The seed from the progeny rows of two selected plants (K.3-2 and K.8-2) was planted out on increase plots of seven and four acres respectively. K.3-2 appears to be more regular in habit of growth and general plant construction than K.8-2; it is also earlier. At present K.8-2 is more regular in staple length, but owing to the earliness and uniformity in habit of K.3-2, it has been decided to issue seed for planting in the Sigatoka district during the coming season from the bulk plot of this selection, and the probable seed requirements for the whole of this district should be more than met. At the time of writing the plot has yielded 4,880 lbs. of seed cotton which works out at 697 lbs. per acre, this will probably be doubled by the end of the season.

*New Selections.*—Twenty plants have been selected for growing in progeny rows next year. Five of the best plants have been selfed, and five have been back-crossed with Sea Island with the object of improving the lint in length and texture. These will be grown in single lines and isolated during the coming season.

RE-SELECTIONS.

| *Strain.* | *Yield Seed Cotton per Plant. gms.* | *Mean Wt. Seed Cotton per Boll. gms.* | *Lint Index.* | *Ginning %.* | *Staple Length. mms.* | *Seeds per Loculus.* | *Loculus No. per Boll.* | *Wt. of 100 Seeds. gms.* |
|---|---|---|---|---|---|---|---|---|
| K.3-1 ... | 323 | 4·18 | 7·48 | 36 | 30 | 7·00 | 3·4 | 12·93 |
| K.3-2 ... | 531 | 3·75 | 7·41 | 36 | 33 | 6·80 | 3·2 | 13·29 |
| K.3-3 ... | 163 | 4·24 | 6·81 | 31·5 | 38 | 6·85 | 3·0 | 13·00 |
| K.3-4 ... | 320 | 3·33 | 7·4 | 33 | 36 | 7·4 | 3·6 | 11·93 |
| K.3-5 ... | 522 | 3·70 | 7·58 | 33·25 | 36 | 6·11 | 3·6 | 13·35 |
| K.3-6 ... | 416 | 4·10 | 6·6 | 34·5 | 34 | 6·47 | 3·8 | 12·04 |
| K.3-7 ... | 366 | 4·01 | 6·14 | 36·25 | 38 | 6·14 | 3·8 | 11·52 |
| K.3-8 ... | 625 | 3·51 | 6·11 | 34·75 | 35 | 6·43 | 3·2 | 11·83 |
| K.3-9 ... | 724 | 4·23 | 8·6 | 37·25 | 35 | 6·45 | 3·2 | 11·09 |
| K.3-10 ... | 578 | 3·89 | 7·21 | 37 | 33 | 6·11 | 3·4 | 13·25 |

Selfed Plants.

| Strain. | Yield Seed Cotton per Plant gms. | Mean Wt. Boll. gms. | Mean Maximum Lint Length. mms. | Lint Index. | Ginning %. | Seeds per Loculi. | Loculus Number. | Wt. of 1,00 Seeds. gms. |
|---|---|---|---|---|---|---|---|---|
| K3.2-1 ... | 617 | 3·56 | 32 | 6·37 | 32 | 6·3 | 3.3 | 13·32 |
| K3.2-2 ... | 495 | 4·00 | 32 | 7·41 | 35·5 | 6·72 | 3·6 | 12·57 |
| K3.2-3 ... | 299 | 4·65 | 33·5 | 6·96 | 37·75 | 6·8 | 3·2 | 10·10 |
| K3.2-4 ... | 478 | 3·29 | 32 | 5·56 | 33·5 | 6·18 | 3·2 | 10·33 |
| K3.2-5 ... | 460 | 4·09 | 31 | 7·80 | 37 | 7·52 | 3·0 | 12·93 |
| K3×S1... | 445 | 3·51 | 33 | 7·93 | 35·25 | 6·8 | 3·4 | 14·88 |
| K3×S2... | 587 | 3·96 | 38 | 7·05 | 33·5 | 6·27 | 3·6 | 12·48 |
| K3×S3... | 535·5 | 4·57 | 33 | 6·87 | 34 | 6·80 | 3·4 | 12·90 |
| K3×S4... | 360 | 5·39 | 38 | 8·09 | 38 | 7·15 | 3·8 | 13·78 |
| K3×S5... | 775 | 4·35 | 34 | 7·21 | 34·75 | 6·63 | 3·8 | 12·54 |

*Spacing Tests in K.3-2 Type.*—The experiment is inconclusive as plots are in various stages of maturity. The table given hereunder indicates the results obtained up to the time of writing, but no sound deductions can be drawn from them as yet.

Spacing Tests.

| Plot No. | Spaces between Rows. feet. | Spaces between Plants. feet. | Yield per Plot. lbs. | Yield per Acre. lbs. | Mean. lbs. |
|---|---|---|---|---|---|
| 1 ... ... | 8 | 6 | 127 | 508 | 572·5 |
| 2 ... ... | 7 | 5 | 44 | 176 | 403·5 |
| 3 ... ... | 6 | 5 | 85·5 | 342 | 644 |
| 4 ... ... | 7 | 3 | 219·5 | 878 | 855 |
| 5 ... ... | 8 | 6 | 159·25 | 637 | — |
| 6 ... ... | 7 | 5 | 226 | 904 | — |
| 7 ... ... | 6 | 5 | 236·5 | 946 | — |
| 8 ... ... | 6 | 5 | 208 | 832 | — |

*K.8-2 Selection.*—This strain is being treated in a similar manner to K.3-2, but as it is later, the only data worth recording are those

which have been obtained from the bulk selections. Picking is now in full swing, and judging from appearances all plots should average well over 1,000 lbs. to the acre.

In plant habit this strain shows slightly more heterozygosity than K.3-2, but the lint samples are a little more regular.

RE-SELECTIONS FROM K.8-2.

| *Strain.* | *Ginning %.* | *Lint Index.* | *Weight of 100 Seeds. gms.* | *Length of Staple. mms.* |
|---|---|---|---|---|
| K.8.2-1 ... ... ... | Insuffi | cient material | to record at p | resent. |
| K.8.2-2 ... ... ... | 33 | 6·95 | 13·75 | 38 |
| K.8.2-3 ... ... ... | 31 | 6·69 | 14·0 | 30 |
| K.8.2-4 ... ... ... | 35·75 | 8·0 | 14·0 | 31 |
| K.8.2-5 ... ... ... | 32 | 6·0 | 13·0 | 35 |
| K.8.2-6 ... ... ... | 36·5 | 7·5 | 12·5 | 32 |
| K.8.2-7 ... ... ... | 34 | 7·15 | 14·69 | 34 |
| K.8.2-8 ... ... ... | 38 | 5·85 | 11·70 | 38 |

*Ratooning Experiments.*—Six lines from types K.3, K.8, and K.11, were ratooned at different dates, and in order to form a comparison between the ratoon and annual plants, six lines were planted with seed from each type, and the seed cotton from each plot was weighed separately. The seed cotton from one boll from 100 consecutive plants in each plot was picked at various periods throughout the season. These samples were weighed and tests were made for ginning percentage, lint index, etc. In each case the cotton from the ratoon lots was found to be inferior to that from the annual. Conditions did not permit of the tests being carried out on very efficient lines, and it is hoped to repeat the experiment more methodically during the coming season. From results obtained it appears that the best time to ratoon would be about December and January. Plants which are ratooned earlier reach maturity during wet weather when picking conditions are unfavourable. In order to compare the resistance of the ratoon and annual plants against pests and diseases, weekly flowering, squaring, and bolling records were kept for each type, and as far as it was possible records showing the amount of shedding due to pink bollworm, tipworm (*Earias fabia*), and other causes.

In the following table of yields it should be pointed out that not more than 60% of the annual cotton has been picked as yet :—

RATOON AND ANNUAL PLOTS.

| Type. | Date Ratooned. | Area in Square Chains. | Date First Picking. | Date Last Picking. | Yield per Plot. lbs. | Yield per Acre. lbs. | Remarks. |
|---|---|---|---|---|---|---|---|
| K.3 ... ... | 3/10/28 | 1·25 | 5/2/29 | 23/8/29 | 26·5 | 212 | Pickings completed |
| K.8 ... ... | 9/10/28 | 1·5 | 16/5/29 | 23/8/29 | 15·25 | 101·6 | ,, |
| K.8 Annual ... | — | 1·56 | 30/7/29 | Not completed | 25·00 | 160·25 | Estimated 50% picked |
| K.11 ... ... | 9/11/28 | 4·00 | 14/6/29 | 17/10/29 | 280·0 | 700·0 | Ratooned to 3′ 6″ |
| K.11 ... ... | 12/11/28 | 3·35 | 14/6/29 | 17/10/29 | 179·25 | 535·0 | Ratooned to ground |
| K.11 Annual ... | — | 3·6 | 30/7/29 | Not completed | 312·5 | 868·05 | Estimated 70% picked |

LINT CHARACTERS, RATOON AND ANNUAL PLOTS.

| Type. | Date. | Ginning %. | Lint Index. | No. of Bolls per lb. | Wt. of Seed Cotton from 100 Bolls. gms. | Ratoon or Annual. |
|---|---|---|---|---|---|---|
| K.3 ... ... | 5/2/29 | 32·5 | 5·16 | 139 | 280 | Ratoon |
| K.3 ... ... | 12/3/29 | 32 | 5·17 | 159·5 | 284 | ,, |
| K.3 ... ... | 21/3/29 | 32·5 | 5·05 | 154·08 | 294 | ,, |
| K.3 ... ... | 2/4/29 | 33 | 5·46 | 148·52 | 305 | ,, |
| K.3 ... ... | 27/5/29 | 37 | 5·36 | 150·5 | 300 | ,, |
| K.8 ... ... | 2/4/29 | 36 | 5·85 | 145·0 | 312 | ,, |
| K.8 ... ... | 16/4/29 | 36·25 | 5·85 | 139·98 | 323 | ,, |
| K.8 ... ... | 27/5/29 | 36 | 6·30 | 145·0 | 307 | ,, |
| K.8 ... ... | 12/6/29 | 38 | 6·56 | 149·0 | 304 | ,, |
| K.8 ... ... | 25/6/29 | 37·5 | 6·08 | 147·0 | 308 | ,, |
| K.11 ... ... | 25/6/29 | 33·5 | 6·43 | 122·0 | 371 | ,, |
| K.11 ... ... | 15/7/29 | 34 | 6·37 | 121·47 | 373 | ,, |
| K.11 ... ... | 4/7/29 | 32 | 6·37 | 132·84 | 341 | Ratooned to ground |
| K.3-2 ... ... | 20/6/29 | 31 | 5·85 | 124·45 | 364 | Annual |
| K.3-2 ... ... | 5/7/29 | 31 | 6·57 | 107·09 | 423 | ,, |
| K.3-2 ... ... | 15/10/29 | 34 | 7·89 | 105·66 | 438 | ,, |
| K.8-2 ... ... | 15/10/29 | 34 | 7·34 | 111·03 | 432 | ,, |

Shedding Experiments.

| | *K.3 Ratoon Plant No. 1.* % | *K.3 Ratoon Plant No. 2.* % |
|---|---|---|
| Shedding due to tipworm ... | ·53 | 1·42 |
| Shedding due to pink bollworm... | ·95 | ·90 |
| Shedding due to other canses ... | 5·70 | 5·00 |
| Total ... ... ... ... | 7·18 | 7·32 |

| | *K.8 Ratoon Plant No. 1.* % | *K.8 Ratoon Plant No. 2.* % |
|---|---|---|
| Shedding due to tipworm ... | ·23 | 4·13 |
| Shedding due to pink bollworm ... | 1·71 | ·37 |
| Shedding due to other causes ... | 4·17 | 5·82 |
| Total ... ... ... ... | 6·11 | 10·32 |

| | *K.8-2 Annual Plant No. 1.* | *K.8-2 Annual Plant No. 2.* |
|---|---|---|
| Shedding due to tipworm ... | 6·00 | 4·00 |
| Shedding due to pink bollworm ... | ·85 | ·33 |
| Shedding due to other causes ... | 4·40 | 3·80 |
| Total ... ... ... ... | 11·25 | 8·13 |

## Crosses.

Selfed seed from the F.1 Meade x Sea Island cross was planted in lines on an area well isolated from all other cottons. The resultant F.2 is quite interesting and consists of 357 heterozygous or mulish types, 27 true Meade types, and 12 Sea Island types in the ratio of $29\frac{3}{4} : 2\frac{1}{4} : 1$.

Amongst the 357 heterozygous plants there were seven plants possessing large four- and five-locked bolls the lint of which gave a full two inch staple. The remaining plants are a mixture of useless rubbish. A further report giving more detail will be forwarded at the end of the season, but at present there is insufficient material to work with.

## Pests and Diseases.

*Stainers.* (*Dysdercus Insularis*).—All cotton has been remarkably free from stainers this season. This seems most peculiar, as one would have expected the ratoon cotton to have carried them over from last season. There are a few nymphs about now, but remarkably few, and there is very little stained cotton.

*Pink Bollworm.*—Hardly any pink bollworm is in evidence on either variety of cotton. It has been heavily parasitised by a Braconid known as *Apanteles platysdræ*. There is also a Chalcid which attacks it. The

Government Entomologist in an experiment obtained a parasitism by this Chalcid of 15% of the pupae of Platyedra.

*Jassid.*—This pest gave more trouble than any other, and during April, May and June, when it caused a great amount of square and flower shedding. It is a species of *Empoasca*. With the advent of drier weather in July it completely disappeared.

*Harlequin Bug* (*Tectocoris lineola*).—Very little was noticed; periodical collections were made by hand, and this seemed to keep it in check. A few broods of nymphs are beginning to hatch out now.

*Tipworm* (*Earias fabia*).—Tipworm did very little damage to flowering squares as far as terminal branches were concerned.

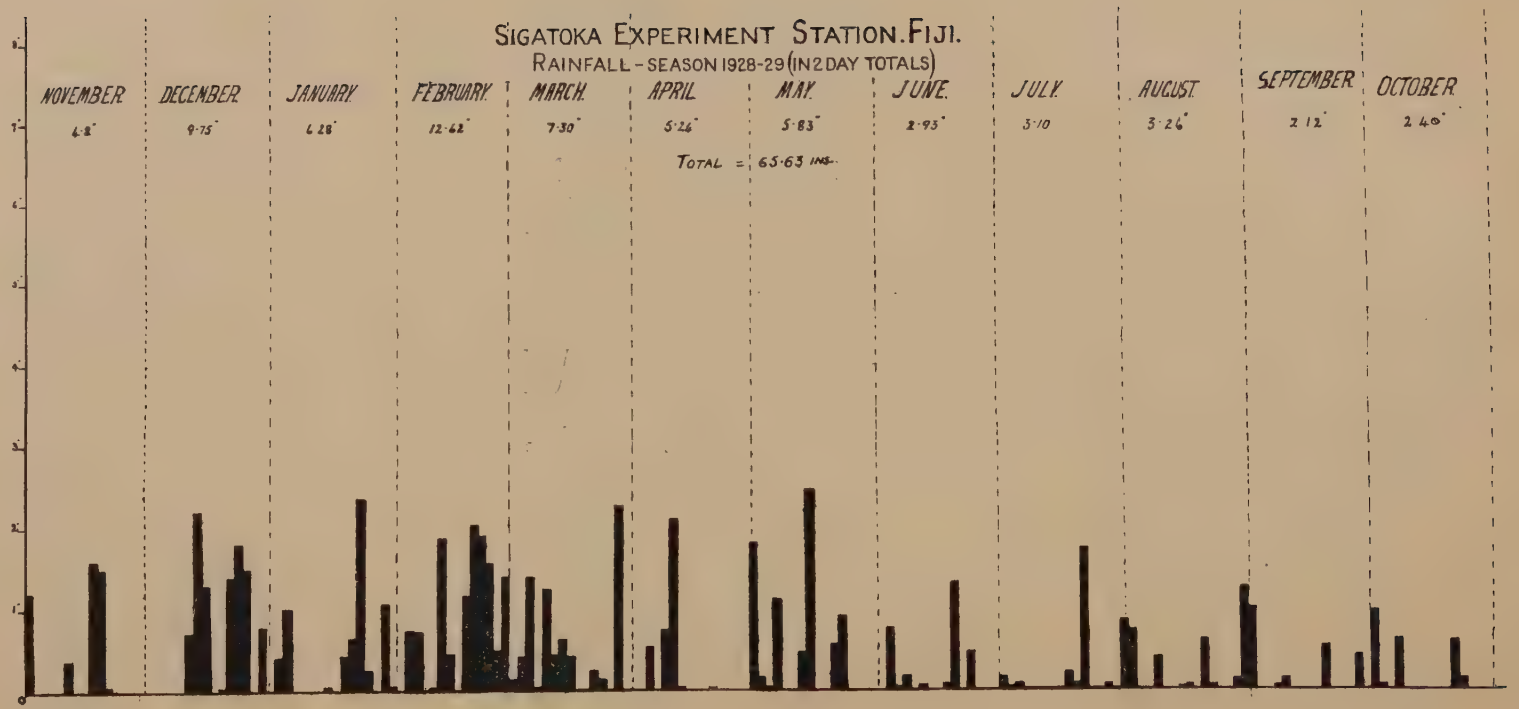
### Conclusion.

It appears that growers are much more satisfied now, and during the coming season it is probable that a larger area will be planted with both varieties.

The seed from the increase plots of K.3-2 will replace the more heterogeneous issue of last season.

It is very pleasing to see the interest that is being taken in cotton-growing by the Fijians; more and more are taking it up each season. If given a little assistance to enable them to purchase their own ploughs and cultivators, there is every reason to believe that the present area under cotton would be doubled in the Sigatoka district alone.

The new variety of cotton is showing great promise and appears to possess wonderful resistance to wet and humid conditions; the staple is improving each year, and although it is possible that the Government may lose a little money on it for the first year or so, it is believed that it will ultimately become a thorough success.


SIGATOKA EXPERIMENT STATION. FIJI.
RAINFALL - SEASON 1928-29 (IN 2 DAY TOTALS)
NOVEMBER 4·8"
DECEMBER 9·75"
JANUARY 4·28"
FEBRUARY 12·62"
MARCH 7·30"
APRIL 5·24"
MAY 5·83"
JUNE 2·93"
JULY 3·10
AUGUST 3·26"
SEPTEMBER 2·12"
OCTOBER 2·40"
TOTAL = 65·63 INS.

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# EMPIRE COTTON GROWING CORPORATION

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## *List of Publications issued to date.*

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